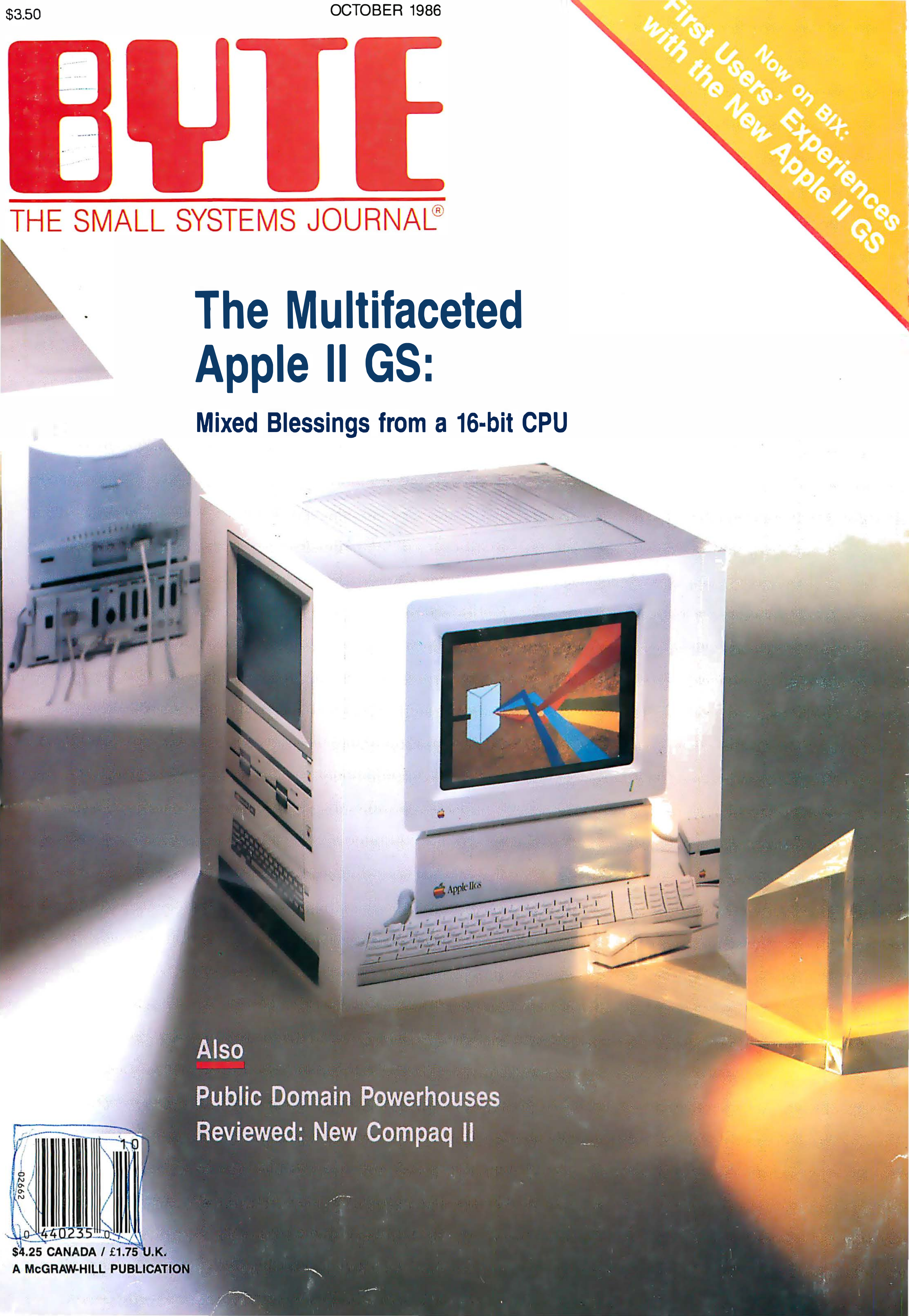
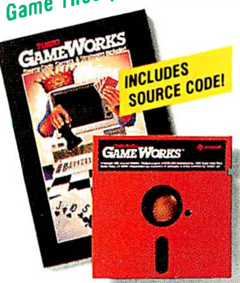


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Turbo Pascal Programming!

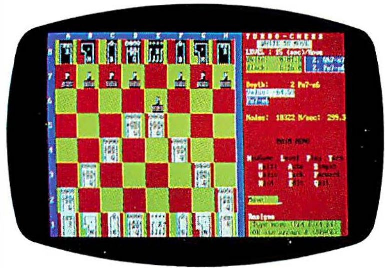
Learn Secrets, Strategies, Game Theory!



$10.00 Scratch 'n Win Rebate!

Turbo GameWorks®

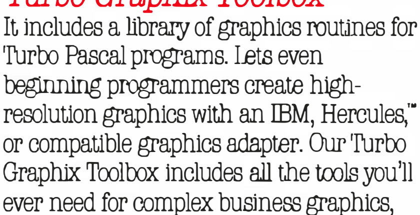
Also recently released, Turbo GameWorks is what you think it is: "Games" and "Works." Games you can play right away (like Chess, Bridge and Go-Moku), plus the Works—which is how computer games work. All the secrets and strategies of game theory are there for you to learn. You can play the games "as is" or modify them any which way you want. Source code is included to let you do that, and whether you want to write your own games or simply play the off-the-shelf games, Turbo GameWorks will give hours of diversion, education, and intrigue. George Koltanowski, Dean of American Chess, and former President, United States Chess Federation, reacted to Turbo GameWorks like this: "*With Turbo GameWorks, you're on your way to becoming a master chess player.*" And Kit Woolsey, writer, author, and twice Champion of the Blue Ribbon Pairs, wrote, "*Now play the world's most popular card game—Bridge . . . even program your own bidding and scoring conventions.*" Suggested retail: $69.95. Use a $10.00 Scratch 'n Win Rebate and you're talking an *incredible $59.95!* Minimum memory: 192K.



Turbo GameWorks' Chessboard

Create Your Own High-Res Graphics!





$10.00 Scratch 'n Win Rebate!

Turbo Graphix Toolbox®

It includes a library of graphics routines for Turbo Pascal programs. Lets even beginning programmers create high-resolution graphics with an IBM, Hercules,™ or compatible graphics adapter. Our Turbo Graphix Toolbox includes all the tools you'll ever need for complex business graphics, easy windowing, and storing screen images to memory. It comes complete with source code, ready to compile. Suggested retail: $69.95, but with a $10.00 Scratch 'n Win Rebate, *only $59.95!* Minimum memory: 192K.





$10.00 Scratch 'n Win Rebate!

COMPLETELY NEW VERSION!

Turbo Tutor® 2.0

The new Turbo Tutor can take you from "What's a computer?" through complex data structures, assembly languages, trees, tips on writing long programs in Turbo Pascal, and a high level of expertise. Source code for everything is included. New split screens allow you to put source text in the bottom half of the screen and run the examples in the top half. There are quizzes that ask you, show you, tell you, teach you. You get a 400-page manual—which is not as daunting as it sounds, because unlike many software manuals, it was not written by orangutans. Suggested retail: $39.95. Use a $10.00 Scratch 'n Win Rebate and you're down to an *unheard of $29.95!* Minimum memory: 192K.



Recognition for Borland International has come from business, trade, and media, and includes both product awards and awards for technical excellence and marketing.

America's Cup. Coming Soon!

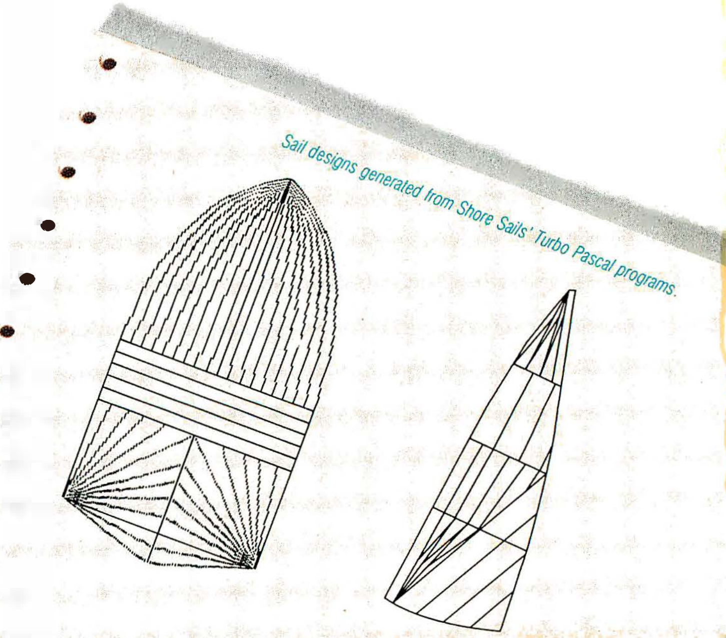
How to use Scratch 'n Win Rebates

It's really simple. You purchase the product between 9/5/86 and 3/31/87, and return the license agreement along with dated proof of purchase and your rebate card. We'll mail you a check for $10.00 on single product purchases or a check for $15.00 when you buy an advertised "bundle"—which means our Turbo Pascal Jumbo Pack, or Turbo Lightning and Lightning Word Wizard, or Reflex: The Analyst and Reflex Workshop, or SideKick and Traveling SideKick. (Restrictions do apply. Rebates are not valid in combination with any other Borland or dealer discount. See Official Rules on back of Instant Winner card).

Send a buck to the boat!

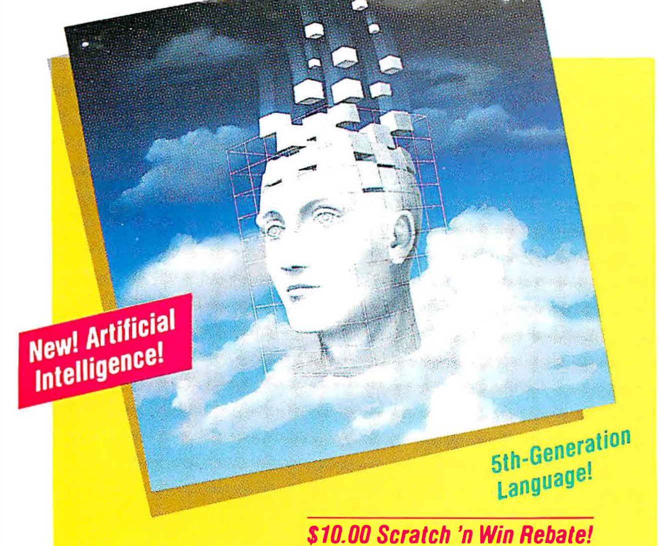
If you'd like to help America's effort to recapture the America's Cup from Australia, you can make a tax-deductible donation to "Heart of America" Challenge, 11 South LaSalle St., Suite 1670, Chicago, Illinois 60603





Sail designs generated from Shore Sails' Turbo Pascal programs.

Turbo Pascal Programming!



$10.00 Scratch 'n Win Rebate!

Turbo Prolog™

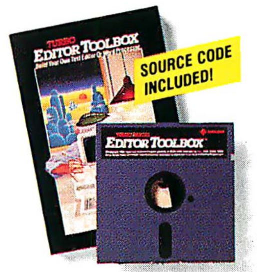
> **"If you're at all interested in artificial intelligence, databases, expert systems, or new ways of thinking about programming, by all means plunk down your $100 and buy a copy of Turbo Prolog."**
> **Bruce Webster, BYTE**

"Borland International, Inc. is gunning onto the fast track in the artificial intelligence and engineering-language-software race, riding aboard a new $99 Turbo Prolog," says Tom Schwartz in *Electronic Engineering Times.* And so we are. Our new Turbo Prolog has drawn rave reviews—which we think are well deserved—because Turbo Prolog brings 5th-generation language and supercomputer power to your IBM PC and compatibles. Turbo Prolog is a high-speed compiler for the artificial intelligence language, Prolog, which is probably one of the most powerful programming languages ever conceived. We made a worldwide impact with Turbo Pascal and you can expect the same results and revolution from Turbo Prolog, the natural language of artificial intelligence. Darryl Rubin, writing in *AI Expert* said, *"Turbo Prolog offers generally the fastest and most approachable implementation of Prolog."* Suggested retail, $99.95. Use a $10.00 Scratch 'n Win Rebate and that goes down to only *$89.95!* Minimum memory: 384K.

Technical Specifications:

TURBO PASCAL 3.0 Minimum memory: 128K, includes 8087 and BCD features for 16-bit MS-DOS and CP/M-86 systems. CP/M-80 version minimum memory: 48K; 8087 and BCD features not available. ***TURBO DATABASE TOOLBOX*** Minimum memory: 128K. CP/M-80 minimum memory: 48K. Requires Turbo Pascal 2.0 or later. ***TURBO GRAPHIX TOOLBOX**** Minimum memory: 192K. Requires PC/MS-DOS 2.0 or later, Turbo Pascal 3.0, and IBM CGA, Hercules Monochrome Card or equivalent. ***TURBO TUTOR 2.0*** Minimum memory: 192K. CP/M-80 version minimum memory 48K. Requires PC/MS-DOS 2.0 or later and Turbo Pascal 3.0. ***TURBO EDITOR TOOLBOX**** Minimum memory: 192K. Requires PC/MS-DOS 2.0 or later and Turbo Pascal 3.0. ***TURBO GAMEWORKS**** Minimum memory: 192K. Requires PC/MS-DOS 2.0 or later and Turbo Pascal 3.0. ***TURBO PROLOG**** Minimum memory: 384K. ***REFLEX: THE ANALYST**** Minimum memory: 384K. Requires IBM CGA, Hercules Monochrome Card or equivalent. Works with Intel's AboveBoard-PC and -AT; AST's RAMpage! and RAMpage! AT; Quadram's Liberty-PC and -AT; Tecmar's 640 Plus; IBM's EGA and 3270/PC; AT&T's 6300 and many others. ***REFLEX WORKSHOP**** Minimum memory: 384K. Requires Reflex: The Analyst. ***TURBO LIGHTNING**** Minimum memory: 256K. Two disk drives required. Hard disk recommended. ***LIGHTNING WORD WIZARD**** Minimum memory: 256K. Requires Turbo Lightning. Turbo Pascal 3.0 required to edit source code. ***SIDEKICK**** Minimum memory: 128K. ***TRAVELING SIDEKICK**** Minimum memory: 256K. ***SUPERKEY**** Minimum memory: 128K. *For IBM PC, AT, XT, PCjr and true compatibles only, running PC/MS-DOS 2.0 or later.

Build Your Own Word Processor!



$10.00 Scratch 'n Win Rebate!

Turbo Editor Toolbox™

Recently released, we called our new Turbo Editor Toolbox a "construction set to write your own word processor." Peter Feldmann of *PC Magazine* covered it pretty well with, *"A 'write your own word processor' program for intermediate level programmers, with lots of help in the form of prewritten procedures covering everything from word wrap to pull-down windows."* Source code is included, and we also include MicroStar, a full-blown text editor with pull-down menus and windowing. It interfaces directly with Turbo Lightning to let you spell-check your MicroStar files. Jerry Pournelle of *BYTE* magazine said, *"The new Turbo Editor Toolbox is the Turbo Pascal source code to just about anything you ever wanted a PC-compatible text editor to do."* Suggested retail: $69.95. Use a $10.00 Scratch 'n Win Rebate and you'll get all this for *only $59.95!* Minimum memory: 192K.



MicroStar file directory accessed by pull-down menu

Borland's Business Productivity Programs:

Reflex: The Analyst™ Analytical database manager. Provides complete, new look at data normally hidden by programs like 1-2-3® and dBASE.® Best report generator for, and complement to, 1-2-3.

Reflex Workshop™ Important new addition to Reflex: The Analyst. Gives you 22 different templates to run your business right.

SideKick® Complete RAM-resident desktop management includes notepad, dialer, calculator and more.

Traveling SideKick® Electronic version of business/personal diaries, daytime organizers; works with your SideKick files; important professional tool.

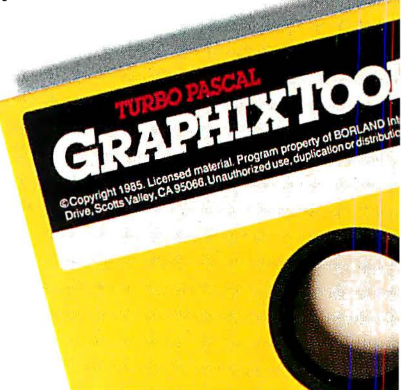
SuperKey® Keyboard enhancer. Simple macros turn 1000 keystrokes into 1. Also encrypts your files to keep confidential files confidential.

Borland's Electronic Reference Programs:

Turbo Lightning® Works with all your programs and checks your spelling *while you type!* Includes 80,000-word Random House® Concise Word List and 50,000-word Random House Thesaurus. Forerunner of Turbo Lightning Library.™

Lightning Word Wizard™ Includes ingenious crossword solver and six other word challenges. If you're into programming, Lightning Word Wizard is also a development toolbox and the technical reference manual for Turbo Lightning.





How Borland is helping bring the America's Cup back to America!

"I think those who grasp the technology will prevail"

Bill Shore, President,
Shore Sails Co., Newport, RI

HEART OF AMERICA

Borland's Philippe Kahn at the helm of America's Cup challenger "Heart of America," with Shore Sails' President Bill Shore

"Sail-making is traditional—a craft—but I think we're huge steps ahead of the competition when we get involved with higher technology," says Shore.

He and Shore Sails' 17 different franchised sail lofts in the U.S. are in what Shore describes as a "highly competitive business, whether it's America's Cup racing or any race." And he adds, "You guys (Borland) do good stuff that's affordable, which is one of the reasons why we wrote all our sail design programs in Turbo Pascal.®"

"These days," he says, "there are many parts to a sail, and Turbo Pascal lets us arrange all the parts properly. We design what the garment industry calls a 'marker'—and rely on Turbo Pascal to do critical things like getting thread lines in the same direction as load lines.

We take the diskette to our new $250,000 laser cutter, which follows the Pascal program precisely, draws out the sail and cuts out the sail. We glue and sew and you've got the best there is."

"The wrong sails will sink your chances—if not your boat—so we wrote Turbo Pascal programs"

Win Fowler, Shore Sails Co., Portland, Maine.

The right sail design, at the right price, right now, has to happen in 17 different Shore Sails Lofts across America.

It had to happen with America's Cup challenger *Heart of America* which carries Shore sails—and it has to happen with the (currently) 700 different boats that Shore Sails has in their Turbo Database Toolbox.™

Sail design, sail pricing and "beating the handicapper" are all done at Shore Sails with Turbo Pascal.

In case you don't know the sharp end from the blunt end of a boat, the right sail design for any boat is more than design and price. It's tactical advantage. Designing sails that take the greatest advantage of the boat's basic design and rigging without getting stuck with a heavier-than-desirable Official Handicap. (Handicaps can eat your chances faster than a Great White.)

The "right sail" design bends but doesn't break the racing rules written by, amongst others, MORR (Midget Offshore Racing Rules) or IOR (International Offshore Rules). Turbo Pascal spills out "right sail" designs for Shore Sails so their customers tend to "handicap" the Rules Committee instead of the other way around.

Shore Sails' connection with Borland doesn't end with Turbo Pascal and our Database Toolbox.

Shore's Fowler has also written SuperKey® macros for "every file we have" and says, "We'd be lost without them."

He uses SideKick® to dial every phone call and SideKick's Notepad to communicate between all the Lofts, saying, "That way we don't need a word processor." Shore Sails also uses Turbo Lightning® and Reflex: The Analyst.®

So why so many Borland products in one company?

Win Fowler says, "We'd be sunk without them!"



"Heart of America" surfing downwind, Santa Cruz, California

Sail designs generated from Shore Sails' Turbo Pascal programs.

Borland's Instant Winner Game

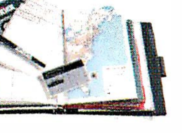
Scratch this card now and you could *instantly win* 2 free round-trip airline tickets to Australia for the America's Cup Race!

$10,000

First Prize ($10,000 value!) includes accommodations for two in Perth, Australia during the final America's Cup races, which start January 31, 1987. See America win it back after our *only* loss in 134 years! There's more than one *instant winner* in Borland's Instant Winner Game, because you could win one of two new $6,895 4-WD Suzuki Samurai convertibles, or a $4,995 AST TurboLaser™ printer, or a $4,499 Toshiba T3100,™ or a $2,399 Toshiba T1100™ Plus, or a $595 AST SixPakPremium™, or a $69.95 Traveling SideKick,® or any one of hundreds of other Borland products—and at the very least a Borland Rebate Coupon, good for $10 off any single product or $15 off any bundled product offer!



$6,895



$69.95

$4,499

See Official Rules on the back of this card for details.

Don't delay! There will be a second-chance drawing for the trip if not claimed by 12/30/86. There's also a second-chance drawing for the two Suzukis if not claimed by 2/26/87. All rebate coupons are good for products purchased 9/5/86-3/31/87. Product prices above are suggested list prices.

Rub the silver box to reveal whether you win a prize or get a rebate coupon. Then fill in the second-chance entry blank to the right.



Second-Chance Sweepstakes Entry!

We're running two Second-Chance Sweepstakes drawings to award the trip and cars. They *will be won* by someone—it *could be you!* Fill in the entry coupon and mail it now. Winners will be notified immediately, because the final America's Cup races start in Australia on January 31, 1987, and you'll have to pack in a hurry.

(You will need a valid passport and the ability to comprehend Australian versions of the English language.)

Name ______________________

Address ______________________

City ______________________

State __________ Zip __________

OFFICIAL RULES - BORLAND INSTANT WINNER GAME

1. NO PURCHASE NECESSARY: To participate, you may obtain a game card inserted into the October, November, December, or January issue of the following magazines: PC World; Byte; PC Tech Journal; PC Magazine. You may also obtain a game card by mailing a self-addressed, stamped envelope to: Borland International Game Card, P.O. Box 870, Wilton, CT 06897. (Washington State residents send self-addressed envelope.) Limit one game card per stamped request. All requests must be received by January 15, 1987.

2. TO PLAY: Remove the rub-off area on the game card to reveal what prize or rebate offer you have obtained

3. PRIZES/ REBATES: Beneath the rub-off area one of the following prizes may be revealed. Trip for Two to America's Cup Races or $10,000; 1986 Suzuki 4W Samurai Convertible or $6,895; AST Turbo Laser; Toshiba 1100 Portable Computer; Toshiba 3100 Portable Computer; AST Six Pakpremium; AST Advantagepremium; AST 3G Pak; AST Rampage; AST Rampage AT; Free Borland Product, or you may obtain the following rebate offer: $10 rebate offer on any individual product or $15 rebate offer on any single advertised Borland bundle (See rule # 11 for prize details.).

4. PRIZE CLAIMS: If you obtain one of the prizes stated in Rule # 3, sign your full legal signature on the game card and send via certified mail (copy should be made for your records) along with your name and address to: Borland International Prize Claim, 196 Danbury Road, Wilton, CT 06897. All prize claims must be received or postmarked by February 15, 1987. (See Rule # 12 for Trip for Two to America's Cup exception.)

5. REBATE CLAIMS: Rebates are good for products purchased from September 5, 1986 through March 31, 1987. The $10 rebate is good for any individual Borland product and the $15 rebate is good for any advertised Borland software bundle. To receive your rebate you must return your completed license agreement from the manual, this game card and dated proof of purchase to Borland International, GameCard Rebate, 4585 Scotts Valley Drive, Scotts Valley, CA 95066. Upon receipt of the license agreement, game card and proof of purchase, Borland will send your check. Rebate is not valid with any other rebate or promotion offered directly from Borland.

6. VERIFICATION: All game materials are subject to verification. Game materials are void and will be rejected if not obtained through authorized, legitimate channels, and may be rejected if any part is reproduced, counterfeited, torn or altered in any way, or if materials contain printing, typographical, or mechanical errors. Decisions of the Redemption Center are final. Game pieces from any game other than the Borland Instant Winner Game may not be used in this game.

7. CONDITIONS OF PARTICIPATION: Material submitted becomes the property of Borland International. The submission of game pieces is the sole responsibility of the individual seeking verification, who is solely responsible for lost, late, or misdirected mail. All taxes, registration and inspection fees are the sole responsibility of the verified winner. Winners may be required to execute an affidavit of eligibility and name and likeness publicity release. By participating in the game you accept and agree to be bound by these rules and the decision of the Official Redemption Center which will be final

8. ELIGIBILITY: Participation is open solely to residents of the United States 18 years of age and over, except employees and agents of Borland International, service agencies, and individuals engaged in the development, production, or distribution of game materials, The Merritt Group, Inc. and their immediate family or members of their households. Void in Vermont and where prohibited by law

9. GAME SCHEDULE AND AWARD OF PRIZES: The Borland Instant Winner Game will commence on or about September 5, 1986 and end on January 30, 1987. It will officially end, however, when all game pieces are distributed. Verified game prizes will be awarded within thirty (30) days from the date of their receipt for verification at the Official Redemption Center. A major prize winners' list can be obtained by sending a stamped, self-addressed envelope to: Borland Instant Winner Game Winners' List, P.O. Box 7089, Wilton, CT 06897.

10. ODDS CHART: The odds of winning prizes are based upon obtaining the one rare game piece among the applicable number of game pieces

PRIZE	Qty.	Total Value	Odds of Winning
Trip for Two to America's Cup or $10,000	1	$ 10,000.00	1 in 6,458,000
Suzuki 4W Samurai Convertible JA or $6,895	2	$ 13,790.00	1 in 3,229,000
AST Turbo Laser	1	$ 4,995.00	1 in 6,458,000
Toshiba Portable Computer	2	$ 6,898.00	1 in 3,229,000
AST Memory Boards	25	$ 15,025.00	1 in 258,320
Borland Products	1,000	$149,000.00	1 in 6,458
OVERALL TOTAL	**1,031**	**$199,708.00**	**1 in 6,264**

All remaining game cards will contain a $10 rebate good on any individual Borland product or a $15 rebate good toward any advertised Borland software bundle

11. PRIZE DETAILS: Trip for two to America's Cup Races (or $10,000) will include coach seating round trip airfare on regularly scheduled commercial airline from San Francisco, California to Perth, Australia and up to two weeks hotel accommodations in Perth, Australia plus $4,500 spending cash. Winners will be responsible for obtaining visa, passport, and all other travel documents. Trip does not include meals, taxes, excess baggage charges and other hotel charges. Minor must be accompanied by parent or legal guardian.

Suzuki 4W Samurai Convertible JA Standard Equipment Package (or $6,895), verified winner will be responsible for all registration, insurance, and licensing fees. AST Turbo Laser; Toshiba Portable Computer Model # T1100; Toshiba Portable Computer Model # T3100; AST Memory Boards and Free Borland Products are non-substitutional except by sponsor due to product availability and all warranties and guarantees are subject to manufacturers terms. All prizes are non-transferrable. Winning consumer is responsible for all local, state and federal taxes.

12. SECOND CHANCE SWEEPSTAKES: There are two Second Chance Sweepstakes drawings scheduled to be conducted on December 31, 1986 and February 28, 1987. Random drawing from all entries received by December 30, 1986 will award trip for two to America's Cup Races (or $10,000). Random drawing from all entries received by February 26, 1987 will award two (2) Suzuki 4W Samurai (or $6,895). All remaining prizes that are unclaimed after February 15, 1987 will remain unclaimed

If you have any questions concerning the Borland Instant Winner Game, call: 1-800-451-4471.

Turbo Pascal Programming!

The Worldwide Programming Standard



$10.00 Scratch 'n Win Rebate!

Turbo Pascal® 3.0

"For the IBM® PC, the benchmark Pascal compiler is undoubtedly Borland International's Turbo Pascal," says Gary Ray of *PC Week*. We and more than 500,000 other people around the world think Mr. Ray got that right. Since launch, Turbo Pascal has become the *de facto* worldwide standard in high-speed Pascal compilers. Described by Jeff Duntemann of *PC Magazine* as the *"Language deal of the century,"* Turbo Pascal is now an even better deal than that—because we've *included* the most popular options (BCD reals and 8087 support). What used

Turbo Pascal now includes free 8087 support and BCD!

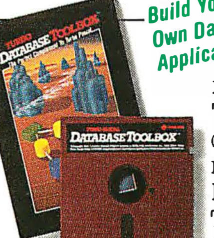
to cost $124.95 is now only $99.95! You now get a lot more for a lot less: the compiler, a completely integrated programming environment, and BCD reals and 8087 support—all for a suggested retail of only $99.95. And with a Scratch 'n Win $10.00 Rebate, you pay *only $89.95*—which really is the "language deal of the century"! Minimum memory: 128K.

$10.00 Scratch 'n Win Rebate!

Turbo Database Toolbox™

A perfect complement to Turbo Pascal, because it contains a complete library of Pascal procedures that allows you to search and sort data and build powerful database applications. Having Turbo Database Toolbox means you don't have to re-invent the wheel each time you write a Turbo Pascal program. It comes with source code for a free sample database—right on disk. The database can be searched by key words or numbers. Update, add, or delete records as needed. Just compile it and it's ready to go to work for you. (Shore Sails has

Build Your Own Database Applications!



more than 700 boat designs and rigs in their Database Toolbox. See front page story.) Suggested retail: $69.95. With a $10.00 Scratch 'n Win Rebate check back from us, *only $59.95!* Minimum memory: 128K.

SPECIAL PRICES! AMAZING VALUE! ACT NOW!

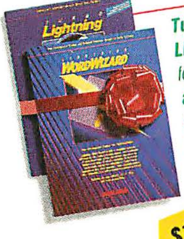
It's the Works! Everything! The whole electronic enchilada! It's the **Jumbo Pack . . . Turbo Pascal 3.0, Turbo Tutor 2.0, Turbo Editor, Turbo GameWorks, Turbo Graphix** and **Turbo Database.** All 6 Turbo Pascal programs for only $299.00—or **only $284.00** with a $15.00 Scratch 'n Win Rebate! That's about $47.00 each and that's a deal!

Turbo Lightning and **Lightning Word Wizard** for only $149.95! and an **amazing $134.95** after a $15.00 Scratch 'n Win Rebate!

$15.00 Scratch 'n Win Rebate on all Xmas packs!

Save a bundle on our bundles!

SideKick and **Traveling SideKick** for only $125.00 but **only $110.00** after a $15.00 Scratch 'n Win Rebate!



Reflex: The Analyst and the new **Reflex Workshop** for only $199.95! And a $15.00 Scratch 'n Win Rebate cuts that down to **only $184.95!**





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For credit card orders or the dealer nearest you
call (800) 255-8008
in CA call (800) 742-1133

Copies	Product	Price	Totals
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___	Reflex: The Analyst	149.95*	$ ______
___	Reflex Workshop	69.95*	$ ______
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___	Turbo Pascal for CP/M-80	69.95	$ ______
___	Turbo Database Toolbox	69.95	$ ______
___	Turbo Graphix Toolbox	69.95	$ ______
___	Turbo Tutor 2.0	39.95	$ ______
___	Turbo Editor Toolbox	69.95	$ ______
___	Turbo GameWorks	69.95	$ ______
___	Turbo Lightning	99.95	$ ______
___	Lightning Word Wizard	69.95	$ ______
___	Turbo Lightning, Lightning Word Wizard	149.95	$ ______
___	SideKick	84.95	$ ______
___	Traveling SideKick	69.95*	$ ______
___	SideKick, Traveling SideKick	125.00*	$ ______
___	SuperKey	69.95	$ ______
	Outside USA add $10 per copy CA and MA res. add sales tax		$ ______
	Amount enclosed		$ ______

Prices include shipping to all US cities.

Carefully describe your computer system:

Mine is: ___ 8-bit ___ 16-bit

I use: ___ PC-DOS ___ CP/M-80 ___ MS-DOS ___ CP/M-86

My computer's name and model is: ______

The disk size I use is: ☐ 3½" ☐ 5¼" ☐ 8"

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*Limited Time Offer

**YES, if within 60 days of purchase you find that this product does not perform in accordance with our claims, call our customer service department and we will gladly arrange a refund.

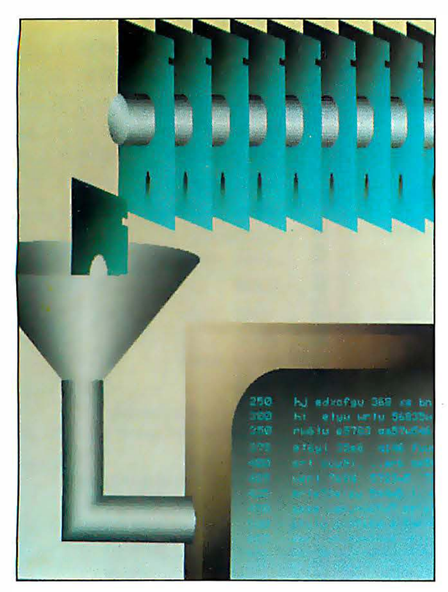
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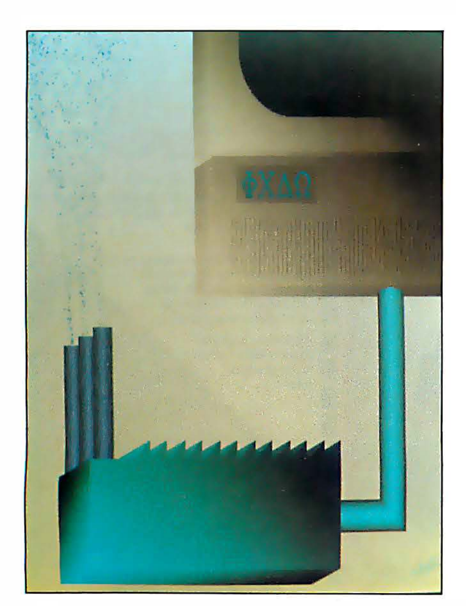
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THEME: PUBLIC DOMAIN POWERHOUSES



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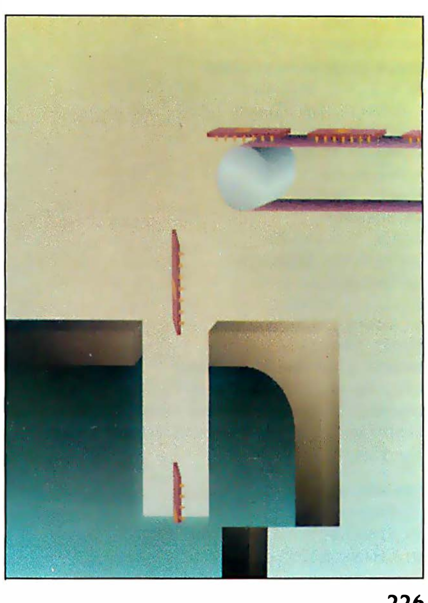
REVIEWS

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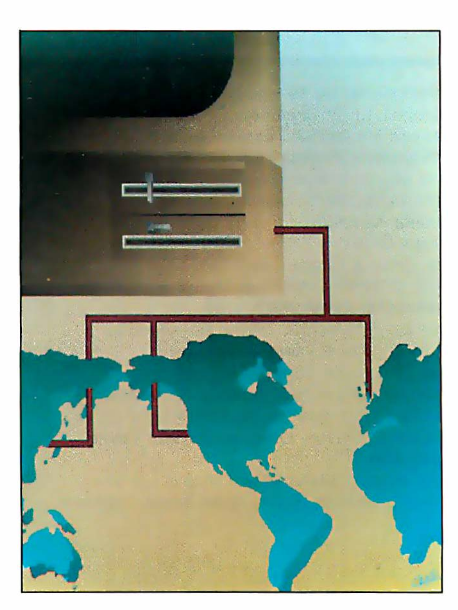
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KERNEL



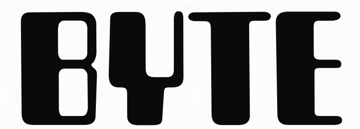
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BEST OF BIX

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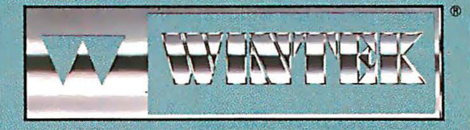
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SIGNS OF VITALITY

Several recent and anticipated developments point to signs of renewed vitality in the personal computer industry. Following are comments on some of these developments.

THE TREND TO OPEN HARDWARE

The new Apple II GS featured on this month's cover has something the attractive and compact Apple IIc was supposed to render obsolete: internal expansion slots. It is widely believed that the new Macintosh will have slots as well. Amiga developers expect a more powerful version of that machine with internal expansion slots. Expansion slots will make all these machines more adaptable and therefore more appealing.

80386-BASED COMPUTERS

The Intel 80386, described in considerable detail in our special issue (the Fall 1986 *Inside the IBM PCs*) to be published later this month, is beginning to appear in personal computers. Programmers who have battled the segment registers of the 8086 and 80286 are rejoicing at the ability of the 80386 to use a vast linear address space. Simplified memory addressing and greater raw computing power will at last make Macintosh-like applications perform at high speed on IBM PC–compatible machines.

68020-BASED COMPUTERS

A new generation of personal computers based on the Motorola 68020 will also appear during the next several months. Apple is hard at work on an open-architecture Macintosh. Commodore seems to be weathering its difficulties and is preparing new versions of the Amiga. Some new Amigas are believed to have 68020s. Atari executives have often spoken of a 32-bit UNIX workstation under development there. The 68020 will make this new generation of machines far more powerful than current models.

IBM'S NEED TO OFFER SOMETHING BETTER

IBM's vulnerability to inexpensive IBM PC compatibles may force the industry leader to lead through superior technology. If IBM is forced to compete on the basis of new technology, computer users everywhere will benefit.

What exactly will IBM do? Most of the talk in the industry suggests a short-term approach featuring a new round of 80286-based PCs with an operating system that uses the protected mode and supports large memory. The new 80286 machines will bundle in everything provided on the best-selling combination boards today. IBM's new 80286 machines will raise the hardware standard for workhorse machines but probably won't convince anyone that IBM has more to offer than other vendors—particularly if other vendors are selling 80386-based machines at prices comparable to IBM's 80286-based machines.

More dramatic departures will come in IBM's 80386 machines—originally scheduled for February 1988 but now more likely to appear in mid-1987. The IBM 80386-based systems will incorporate a great deal of proprietary technology. According to one line of speculation, IBM actually has obtained the rights to the masks of the 80386 and can extend the chip's functionality in proprietary ways. Speculation can run rampant on this theme.

A second line of speculation says that IBM will equip its 80386 machines with ROMs and systems software that implement the LU 6.2 and PU 2.1 protocols of the Systems Network Architecture (SNA) standard. These protocols support peer-to-peer communications, as distinguished from host-to-terminal communications. Large corporations that own IBM mainframes would love to have IBM solve the problem of connecting PCs, minicomputers, and local area networks to mainframes in a convenient way. Bundling LU 6.2 and PU 2.1 would help. The protocols are complex enough that other companies would need at least a year to implement compatible systems. This would give IBM a big advantage in the corporate market.

SUCCESS IN THE HOME

In the eyes of some, the failure of the IBM PCjr doomed the market for home computers. But significant stirrings are again occurring in the home computer market. The software house Electronic Arts, which has never lost its faith in the home computer, saw its revenues grow 55 percent in 1985 and another 100 percent in 1986. The Tandy 1000 EX is the first of a new kind of IBM PC compatible intended for the home. Highly compact, attractively packaged, and relatively inexpensive, this machine will be an appealing home computer for people who use a desktop PC compatible at work. (For more details, see What's New, page 31.)

Open systems, the arrival of personal computers based on the 80386 and the 68020, a new line of workhorse machines from IBM, pressure on IBM to offer end users valuable new technology, and even signs of life for computing in the home—all these will make the next year a watershed in personal computing. We'll do our best to keep you abreast of changes. In addition to coverage here in BYTE, we will host events on BIX for interactive discussion of new developments.

BIX EVENTS FOR OCTOBER

The following special conferences will take place this month: The Apple II GS: First Users' Early Impressions; New Generation Laptops: Compatible Computing on the Go; The IBM RT PC: Which Niche for RISC?; Publishing Your Own Software; and Macintosh in the Sciences.

—*Phil Lemmons*
Editor in Chief

Free BIX Time for Apple II GS Owners

If you're an owner of the new Apple, you may be eligible for a free BIX membership and 10 free hours of connect time. The only qualifications are that you have accepted delivery of an Apple II GS; that you are willing to share your experiences with the new machine by participating in this month's BIX Special Event on the II GS; that you can provide your own modem and telecommunications software; and that you are one of the first 10 persons to call in response to this announcement. To participate, please call Associate Technical Editor Curt Franklin at (603) 924-9281 during normal East Coast business hours.

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Staff-written highlights of developments in technology and the microcomputer industry.

Bell Labs Develops Optical Logic Device, Draws Nearer to Light-Beam Computer

The staff of the optical research department at AT&T's Bell Labs (Holmdel, NJ) reports they've drawn closer to building a computer that uses light beams instead of electrical signals. Alan Huang, division head, claims electronic computers are outrunning the capabilities of integrated circuits; an alternative technology would process data with optical rays rather than electrical impulses. An optical computer could conceivably run 1000 times faster than conventional electronic machines.

One of the biggest obstacles Huang and crew faced was coming up with a device that could control light beams the way transistors control electrical signals. But that problem was at least partially solved when Bell Labs developed a breakthrough optical logic device. Called a SEED (self electro-optic effect device), the optical transistor functions as a NOR gate and, according to Huang, matches electronic logic elements in speed and power. The chip is made of gallium arsenide and aluminum gallium arsenide.

Huang, who's examining alternatives to electronic elements, says that while extensive work remains, his group hopes to build a functional optical computer within three years.

Softguard Working on VM Operating System for the 80386

What do you do if your company's premier software product (in this case, copy-protection systems) is becoming increasingly less popular with both users and manufacturers? Well, if you're part of Softguard Systems (Santa Clara, CA) and you're a former IBM mainframe programmer, you try to get your favorite operating system, VM, running on a microcomputer.

By the second quarter of next year, Softguard hopes to have available for the new 80386-based machines a virtual operating system very similar to that of IBM's VM mainframe. The system will be able to play host to several other operating systems, including MS-DOS and UNIX, and run multiple copies of each of these at the same time. The system should also be able to emulate extended memory systems. Thus, according to Softguard, the VM system will obviate the need for a multitasking version of MS-DOS that can break the 640K-byte memory barrier.

Modeled after IBM's VM/370, the system should be able to run on several of the new 80386-based computers, expected to be available shortly. It should also be able to run on 80386 speedup boards for the IBM PC, XT, and AT. Softguard will make its VM system available only to OEMs, but the company expects the end user to pay under $200.

Commodore Improving Amiga Chips; Has Redesigned Genlock

Jay Miner, general manager at Commodore-Amiga (Los Gatos, CA), says the company is working on an improved version of the Agnus and Denise chips, two of the three custom chips in the Amiga 1000 that provide many of its advanced features. The improved chips will not work in existing Amigas but will be used in a future Amiga-family machine.

The Agnus chip is being upgraded to address 2 megabytes of display memory (the memory that must be used to store all video images) independent of the expansion memory. The current Agnus controls 512K bytes of memory. The bimmer (bit-mapped image manipulator) in the Agnus chip will be able to address 4K pixels at one time, up from the current chip's 1K-pixel capability. The new Agnus and Denise chips will also support higher-resolution, noninterlaced graphics.

Commodore-Amiga has also redesigned its Genlock peripheral to meet FCC radio-frequency interference specifications. (Genlock enables the Amiga's display to overlay an external video signal.) Barring production problems the firm expects to have the product in the stores by November.

(continued)

MIT's Media Lab Produces Holographic Image Generated by Computer

The Media Lab at the Massachusetts Institute of Technology (Cambridge) has demonstrated a small monochromatic hologram of a car. While the hologram in itself is not exactly extraordinary, the car is: It was entirely computer-generated. The so-called "synthetic hologram"—a hologram not of an actual object, but of a computer-generated model of an object—was created by interpolating 130 different views of the car onto a piece of film.

After the film was exposed, it was processed into a semicylindrical hologram, which allowed observers to look at the image from any point within a 180-degree viewing angle. Stephen Benton, associate professor of media technology at the lab's Spatial Imaging Group, described the image as "completely projected into space, suspended." He said the technology involved will someday let architects show buildings in true 3-D instead of on a flat drawing board and let surgeons examine images of body parts before operating.

According to Tim Browne, associate director of the Media Lab, a significant amount of development work remains to be done. The researchers hope to shorten the processing time of the hologram to 24 hours. The process currently requires approximately one week.

They also hope to enlarge the dimensions of the image from its present 8-inch by 4-inch size to something large enough to represent a human body. Other goals include adding full-color images (the car demo is green), 360-degree viewing, and transporting the graphics imaging software to a personal computer.

The researchers expect that a commercial implementation of the technology may be ready within five years.

Manhattan Graphics Claims Desktop Publishing Package Signals "Next Generation"

Manhattan Graphics Inc. (Valhalla, NY), maker of the Ready Set Go page-maker package, is working on what it says will be a "next generation" advance in a Macintosh desktop publishing program. The firm hopes to release the software before Christmas. "Basically it's a major extension of WYSIWYG [what you see is what you get] for desktop publishing," said Ken Abbot, company president. Some packages have a preview mode that lets you view a document in WYSIWYG format before printing. The Manhattan Graphics program will have only one mode, which always provides a WYSIWYG display.

"We see the future for desktop publishing in having one mode [so that] you work with a simulation of the thing [you want to produce] at all times," Abbot said. "The question of one mode is how far you can go and still get professional typographical features."

The forthcoming package is capable of word wrap and hyphenation in real time and in six languages; it will let you choose a range of text and change it from English to Spanish, for example, on the fly (with a menu selection) and have it all fit in the document according to the design parameters in place. The company is considering porting the program to other workstations and to IBM PC AT–style machines under Windows.

NANOBYTES

A spokesperson at **Microsoft** (Redmond, WA) said the company's next-generation operating system for personal computers will have a special high-bandwidth interface to keyboard, mouse, and video. Besides a very high-performance subsystem for user interaction, the operating system will provide networking in a transparent form that can always be present in the background. . . . Sources within **Motorola**'s microprocessor group (Austin, TX) confirm that two new central processing units will be released by that company in the near future. Slated for autumn arrival is the 68030, an integrated version of the 68020 microprocessor. This chip reportedly will include a memory management unit and a math coprocessor. Due in the first quarter of next year is the 20-MIPS 78000 CPU. Sources said the 78000 is a RISC processor that represents an evolutionary progression of the 68020. . . . **AT&T Technology Systems** (Berkeley Heights, NJ) has developed a chip it says is key to implementing an integrated services digital network (ISDN). The new chip, called UNITE, can be used by any builder of telecommunications equipment. It will allow fully digital transmission and reception of voice, data, video, hi-fi audio, and other types of communications over the same wires that carry regular phone calls. . . . A reliable industry source says **IBM** may attempt to stave off compatibles companies by implementing its SNA in ROM in its new personal computers. IBM could then extend its operating system to take advantage of the ROMs. According to the source, builders of PC compatibles would have trouble developing comparable systems quickly. The SNA implementation would simplify connecting IBM's microcomputers with its larger machines.

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SCREAMING COMPUTERS

In all the discussions about the possible health hazards of VDTs, I have seen no mention of what is, for me, an obvious and serious discomfort: the piercing *audio* shriek that is emitted by all standard VDTs. Apparently, most people cannot hear this 15.75-kHz whistle. I belong to the minority that avoids certain intersections where "ultrasonic" motion detectors are deployed and that gets headaches in airports due to the VDTs that are hanging everywhere.

Engineers who design VDTs, switching power supplies, security systems, and so on—please remember that some people do hear all the way to 20 kHz. Please design things so as to lessen the emission of high-frequency audio waves (stiffer flyback transformers?). And please hurry up the transition to higher-resolution video, which is linked to higher scanning rates. For example, the 35-kHz scanning rate in the Atari ST monochrome monitor was a major factor in my decision to go with that system. Having gotten used to it, I can hardly believe that I used computers at all before.

MOSHE BRANER
Ithaca, NY

HORIZONTAL SYNC

While trying to prepare myself for the shock that will surely accompany my first telephone bill after I start using BIX, I have been reading the Best of BIX section with great interest.

I own an Atari ST and was interested to read that Dave Menconi (July, page 399) was having the same problem I had a couple of months ago. The monochrome monitor often moves the screen horizontally, so that one side of the screen wraps around to the other side.

This is not a problem with the ST but with the monochrome monitor. It is easily fixed by opening up the monitor and twiddling a small pot marked "Horizontal Sync." For accuracy, this is best done when the monitor is on and connected to the ST. Of course, this can be dangerous unless extreme care is taken. A plastic screwdriver is essential. The adjustment could also be made on a trial-and-error basis when the monitor is off. It would then be turned on to test the position of the screen.

I have just completed my first piece of commercial software for the ST series and I could certainly have used the help of the BIXen during the early days. I hope to be BIXing soon!

ANDREW R. BENNETT
Harrogate, North Yorkshire
United Kingdom

MATHEMATICS OF PROGRAMMING

May I commend you for your selection of "Mathematics of Programming" by C. A. R. Hoare (August). In addition to the specific points made (lucidly!) by the author, it provides some hope that what good analysts and programmers know intuitively can someday be taught to future toilers specifically.

Hoare's approach would be a significant addition to (and in many instances a substitution for) the variety of mathematical and logical courses now provided would-be analysts/programmers. Many of the current courses are merely dogmatic exercises in complexity.

SETH S. GROSSMAN
Delmar, NY

MATHEMATICS OF MUSIC

We are glad to see that Charles Dodge and Curtis Bahn ("Musical Fractals," June) have made it known to your readers that fractal mathematics is not limited to the graphics screen. We would like to add that there are a great many possibilities not touched upon in that article.

In 1981, Hologramophone Research was formed for the purpose of exploring the possibilities of computer-assisted music. Since then, with the help of the ideas of Benoit Mandelbrot (*The Fractal Geometry of Nature*) and Douglas Hofstadter (*Goedel, Escher, Bach: An Eternal Golden Braid*) we have discovered many ways to take advantage of music's inherent mathematical nature. The computer can be programmed to fractalize real-time acoustical events in any number of ways, so it is valuable as an improvisational (as well as a compositional) tool.

We have found that much of the great music in history can be described by simple fractal formulas, right down to the sounds the instruments make. We believe the fractal concept to be responsible for much of the beauty in nature, and we expect that the next generation of synthesizers will embody a deeper understanding of these possibilities. We would be delighted to correspond with any of your readers who are interested in this field, which, though small, presents boundless potential.

JUSTIN PARKER
PETER MCCLARD
Hologramophone Research
316 Sena St.
Santa Fe, NM 87501

UPDATES FOR ATOMCC

The response to my article "The ATOMCC Toolbox" (April) has been good. Many have approached me for the source code of the program. There must be many more who have obtained the executable and object files from BYTE.

The purpose of this letter is to inform users of ATOMCC that I have found and fixed several important bugs. Of course, all programs of such size will have some bugs, and perhaps some users will simply work around them. However, some of the bugs are rather severe.

Bug #1

While doing research on differential-algebraic equations (DAEs), I found that the ATOMCC compiler did not properly search all the binary tree branches for certain types of equations. For example, the following input equations will produce messages of "undefined operator number

(continued)

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0" and gaps in the object program:

```
DIFF(X,T,1) = X*X
Y = 2*(X + 1 + EXP(-T))/X
  $
  $
  $
  $
```

The tree for the second equation is as shown below, where all the nodes are circled and labeled a to g. The original processing saved all the right branches as nodes and processed the left branches as it went along. Therefore, the nodes pushed down on the stack (MSTK) are, in order, b, d, and e. The correct order of processing sequence is f, g, e, d, c, b, and a. However, since node c was not saved on the stack, the actual processing was c, g, f, e, d, b, and a, which created havoc.

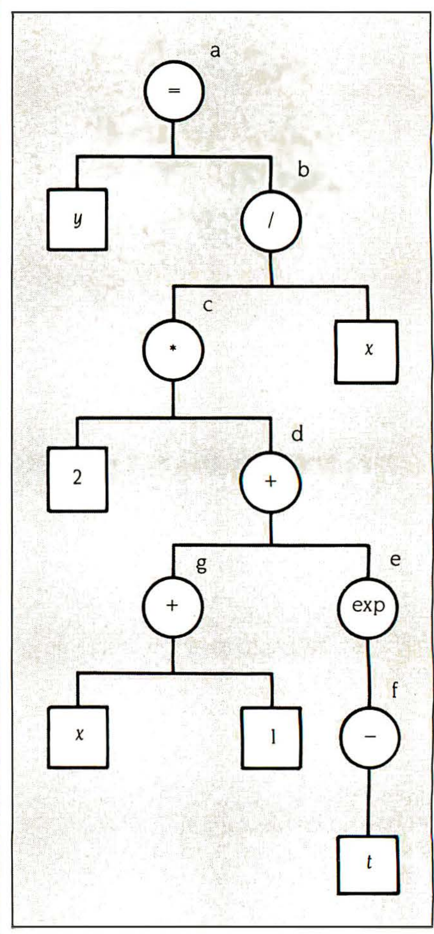


Figure 1: *Tree for* Y=2*(X+1+EXP(−T))/X.

The result was that e did not compile properly, and errors were produced in the object code.

The fix is to force saving onto a stack all the nodes of the binary tree. A subroutine within ATOMCC called FORMAT has

(continued)

been rewritten. The processing is now done correctly without missing any node.

You can work around this bug by breaking up the second equation into smaller parts, such as shown below. You must simplify any equation that may invoke the error message as given above.

```
DIFF(X,T,1) = X*X
Y = 2*PARTA
PARTA = PARTB/X
PARTB = (X + 1 + EXP(-T))
 $
 $
 $
 $
```

Bug #2

Jet Propulsion Labs has had a copy of ATOMCC for over a year, and mathematicians there have made some extensive comparisons of this method with other methods. They have produced a paper on this subject. The bug in question here arose when they tried to submit the entire solar system including relative corrections to ATOMCC. There were over 900 equations. As anyone doing *n*-body problems knows, in such problems there are many exponentials such as (Sun − Earth)**2.

When ATOMCC was first written, we had planned on only a handful of these exponentials. So, the design was to move a certain stack for triplets (MTRPL) up by 50 to make room for these exponential functions. When this number of 50 was exceeded by JPL, the triplets on the stack wrote over onto themselves and produced an infinite loop.

The fix is to use another stack for the input stream (INOUT2), which happens to be the same size as (MTRPL) and which contains the input stream that can be discarded at this stage. Thus, the new design can handle as many of these exponentials as the user may wish to enter. For users who need to solve very large systems of equations, there is no way to work around this bug.

Bug #3

While working on the other bugs, I decided to test the implementation of some of the functions. One of them proved to have an error. There was a misalignment in the output code for the arc tangent function. If you wish to use the arc tangent function, you must obtain the new version of ATOMCC.

Bug #4

In testing ATOMCC, Jet Propulsion Labs used a certain parameter (HMAX) to control the accuracy of the results. JPL had an earlier version of ATOMCC that retained this parameter.

Once I got wind of this, I realized that there was a bug in the RDCV subroutine. The accuracy of the results produced by ATOMCC is properly controlled only by ERRLIM.

The algorithm in the RDCV subroutine comprises three parts. The first part, called three-term analysis, is used to calculate the position and order of a singularity on the real axis. The second part, called six-term analysis, is used to calculate the position and order of a pair of conjugate singularities in the complex plane.

The third part, called top-line analysis, is used to *estimate* the distance of a simple pole with unknown position and order. The first two analyses are based on sound fundamental mathematical bases. The top-line analysis is only an estimate. This estimate is used only when the other two analyses fail.

When the parameter HMAX is used to limit the step size and control the error, the effect is only to reduce the step size when top-line is being used, because the step size is large only when the solution point is between singularities and the other analyses fail. Therefore, there must be an error in top-line. This is a severe bug.

The fix is to completely rewrite top-line. You can raise the parameter MPRINT to 6 or 8 and observe whether top-line is being used appreciably. If it is being used a lot, the accuracy of the results is in doubt. You must then obtain the new version of ATOMCC. This leads to the next bug.

Bug #5

The version of ATOMCC mentioned in the article was version 7.10. It contained a significant advancement over previous versions in that stiff equations could be solved. As mentioned in the user manual, stiff equations are solved only in double precision. What I am leading up to is that I have left a developmental flag in the DRDCV subroutine. This is sort of like a mechanic leaving a screwdriver inside the air conditioning duct propping open an air valve.

What was the purpose of this flag? It was used to bypass the three-term and six-term analyses. What is the result? The result is that only top-line is being used in this subroutine. Examples 3 to 17 of the user manual will not yield any result in double precision. Since three-term and six-term analyses are bypassed, therefore, in double precision, version 7.10 of ATOMCC has poor error control as explained above. This is the most severe bug. The user must obtain version 7.20 if there is much intent to solve problems in double precision.

(continued)

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Added Features

Since Jet Propulsion Labs expressed a desire to solve systems of more than 900 equations, I have made some changes in ATOMCC to accommodate. If the user has sufficient memory capacity (at least a megabyte of RAM would be required), he can use ATOMCC version 7.20 to solve up to 9000 equations or perhaps even more.

Version 7.20 also has an automatic KTRDCV feature where only those variables with the smallest radii of convergence are fully analyzed in the subroutine RDCV. This yields an appreciable savings of computational time in instances when the system of equations to be solved is large.

Another added feature is where the ATOMCC compiler prints out the amount of internal stack spaces being used for each problem versus the total stack spaces available. The user can then see just how much resource is used and how big a problem can be solved by using ATOMCC.

Y. F. Chang
Claremont, CA

Tongue-Tying Voicewriters

In order to clear away hype and set standards, I suggest that the following text be read in clear measured tones to all devices purporting to function as "voicewriters":

> "Cap Ten and my caftan," kept on crying the Captain. "Cap Ten!" Of numbered caps, Cap Ten suited the Captain. He had numbered them as the numb bird landed. "Land dead ahead!" called out the Mate to cawing from the numb bird. Would its gnaw tickle? It cawed, but it was caught on the carpet. "Correction!" the Captain would carp pettily. "Your nautical law has no tickle. We've three types of wreck: surface, deeper, core. Sir, fuss deeper, weave, hear the screw's deep purr. This ship's an old seesaw!" The Captain capped an epigram: "Old sea saw: Correction! Core wreck shun. Cap Ten and my caftan! I, as a Copenhagen Captain, coped on a captstan and kept on coping!"

If the device makes more than five or six errors in transcription (or about one per twenty words dictated), some careful examination of the voicewriting concept may be in order.

While it may seem that this text has been contrived to place a fairly high strain on such machines, the difficulties it presents are not only normal but inevitable. Similar ones are found in everyday spoken English, where not only isolated homonyms but the ordinary internal phonetics of words and phrases can create obstacles to sound and word recognition. In some foreign languages, particularly Chinese and other members of the Sino-Tibetan family, this problem is many times more difficult than in English.

A few years ago there was a great deal of noise to the effect that computers would soon replace "analog," or human, translators. This was before it was realized how difficult the problems of translating natural languages actually are, and now those companies involved in machine translation talk of working with, rather than replacing, the translator.

Some of the same problems involved in machine translation are also present in transcribing spoken words, in some ways in even more acute forms. Hence, it may be a bit premature to talk of replacing

(continued)

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ALEX GROSS
New York, NY

COMBINING LANGUAGES

I would like to comment on the remarks in the June Best of BIX about the similarities and differences between Ada and Modula-2 (pages 376–378).

I believe that the real debate between the proponents of each language should not rest upon whether one should have an "everything but the kitchen sink" philosophy or a "do the rest by yourself" philosophy. The real debate is on how much information a programmer can absorb in learning while remaining proficient at the job and how to increase programming efficiency.

The first philosophy (that of Ada) creates an environment where programmers must absorb an incredible amount of information. They must remember not only the keywords of the Ada language but also a very sophisticated syntax.

In this philosophy, programmers are easily overwhelmed, especially if they already know another language. On the other hand, this philosophy provides an identical environment for all Ada programmers. An Ada programmer can move from one environment to another with very little difficulty.

The second philosophy (that of Modula-2) represents a language stripped down to its essential parts. It becomes a pure and simple tool. What is the problem with that? you might say. There is the lack of an identical environment for all Modula-2 programmers. Having a module capability provides access to independently written functions for doing all sorts of work.

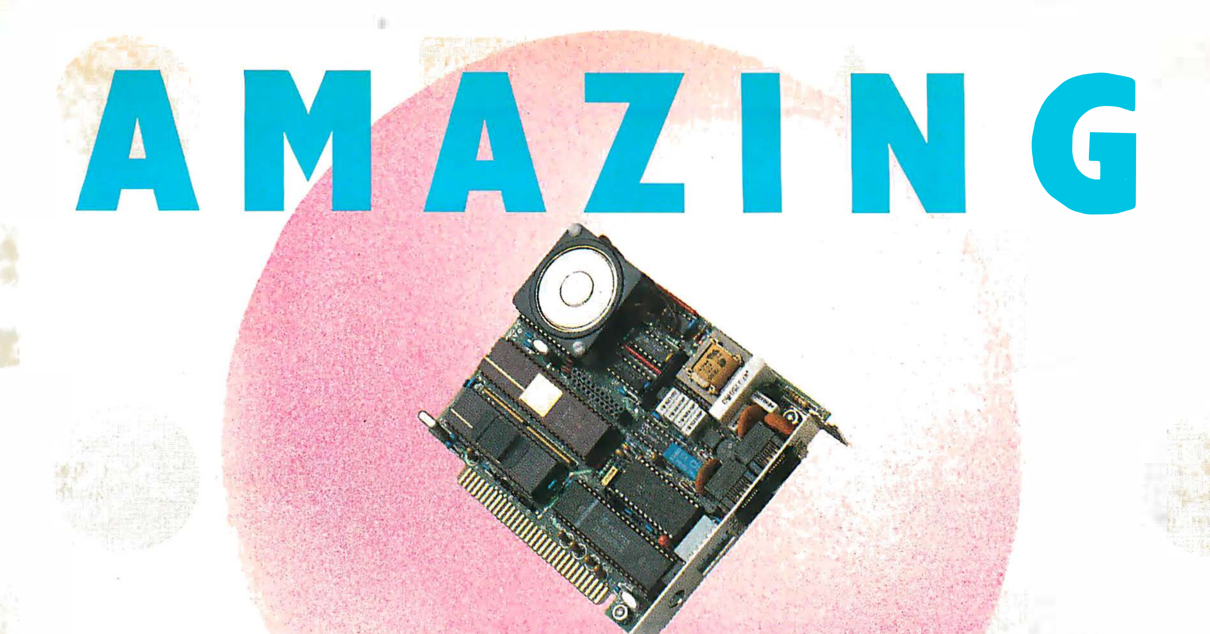
But this capability, if left completely free, can have harmful effects, too. For example, each time Modula-2 programmers have to change systems, they have to relearn the graphics procedures of the other environment. This is a matter of philosophy, not implementation, because, although it would be easy for Modula-2 to define the workings of certain external modules, this clashes with its minimalist philosophy.

Still, the learning problem remains. We become victims of what is commonly called the "tyranny of large numbers" by electrical engineers. This problem arises in the construction of VLSI chips. These chips contain around 200,000 components. It has now become impossible for an engineer to design and lay out one of these chips without the help of logic simulators, circuit simulators, and a slew of computer-aided engineering tools.

If you compare the situation of electrical engineers to that of today's programmers you see that, although programmers are faced with tasks of ever-greater complexity, they do not have the computer tools that will help them perform their jobs with the greatest possible efficiency. Programming as a discipline has not changed since 1959. In other words, we are using 27-year-old technology. We are still entering our programs by hand, still designing them (sometimes) with pencil-drawn flowcharts, and still using simplified documentation systems (i.e., comments). Can you imagine an electrical engineer spreading out a large sheet of paper on the kitchen table to design even a very simple microprocessor? Yet many programmers are faced with tasks of this complexity.

What programmers really need is not a

(continued)



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single "do it all" language but an environment providing tools for creation, verification, and documentation of programs. Who cares if the program is written in five different languages if each one is used to perform a task it is intended for. The goal of a programmer is not to program in a certain language but to produce a program. Loyalty to a programming language is ridiculous! The end justifies the means. It would seem logical to call these systems computer-aided programming (CAP). Unfortunately, these systems do not have widespread use. Instead of worrying about user-friendliness, how about worrying about programmer-friendliness a little bit? If programmers are given better working conditions, they will find it easier to produce user-friendly interfaces. It seems evident that more effort will be put into designing something if the design process becomes simpler.

You may be wondering why I wrote this letter. I am an 18-year-old student and I find it difficult to understand why grown men can be such crybabies when it comes to computer languages. I also find it hard to believe that, after 27 years, we do not have commercial CAP systems readily available for many machines such as the IBM PC or the Macintosh. At a time when businesses talk about "efficiency" and "productivity," I find this aberrant.

Although I have voiced a number of strong opinions, I would like to thank you for producing the Best of BIX column. It provides an excellent forum for user feedback and lets many of us, who do not access BIX directly, benefit from the experiences of others. Although I do not always agree with many of the comments, I enjoy reading them very much.

RONALD J. PERRELLA
St. Jean de Braye, France

ACCESSING FOREIGN ON-LINE SERVICES

I have been following the discussion of international access to data networks, and I'd like to add my part of the story.

I have called different on-line services from Argentina, where the organization of telephone lines, as well as the access to data networks, is government-controlled, as in Europe.

The rates are $12 an hour, plus $.58 per kilosegment, plus the call to the local node, about $.60 an hour.

There's no membership nor minimum usage and neither annual nor monthly fees. I noticed that some readers had complaints about some on-line services billing a surcharge for the network usage within the U.S., which added to the service fee plus the international access, which increases the overall cost even more. There is, however, an on-line service that not only doesn't surcharge for network usage, but also has a flat, 24-hour fee for international users. This system is Delphi, which is located in Cambridge, Massachusetts.

Anyway, all the letters up to this point have been about access *to* the U.S. What about access *from* the U.S. to foreign on-line services? I moved to the U.S. last December, and since then I haven't been able to call the Argentinian systems. Maybe a reader can come up with some idea? I called the network's customer support numbers without success.

JAVIER HENDERSON
Alta Loma, CA

INVERSION DIVERGENCE

After reviewing "Inverting Large Matrices" by Thomas E. Phipps (April), we ran the program on page 186 without lines 150

(continued)

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Inquiry 62

and 160. We found that the technique was highly oscillating in nature and diverged within 5 iterations. With the above lines, the program converged in 5 minutes, 20 seconds with 14 iterations. We would like to hear the author's comments on this.

H. V. Ramakrishnan
Bombay, India

Dr. Ramakrishnan is quite correct about the instability of the published algorithm for the case in which entries (whether random numbers or user-supplied numbers) are all of one algebraic sign. This took me completely by surprise, since I had assumed that random signs would stress the algorithm more, and I failed to check this unwarranted assumption. Other users of the program have reported occasional instabilities of large-matrix inversions.

The cure for all such problems is immediate if we recognize that the plain Newton's iteration is always stable. The trouble lies in my "improvement" on that algorithm—particularly in my choice of parameter value $m = 4$ in equations 12 and 13, in figure 1 of the article (page 182). The smaller the m value, the greater the assurance of stability. The choice $m = 1$ provides a reliable compromise between speed and assurance of stability for inverting matrices whose real-number entries are all of one sign. ($m = 2$ also works, but $m > 2$ is unsafe.) Thus, in the program listing one just changes line 380 to read

```
380 FOR I=1 TO N:X(I,I)=1+E(I,I):NEXT
```

For greater flexibility, I find it useful to rewrite the program to make m an optional input parameter.

Thomas E. Phipps Jr.
Urbana, IL



New Chip Shipped by Request Only

After visiting COMDEX in Atlanta this spring, we were immensely impressed with the new Star Micronics NX-10. It is without a doubt the best sub-$300 printer available. Having owned a Star Gemini-10X, we were cognizant of Star's exceptional quality, cost, and performance. Immediately, we each ordered one and we were startled at what we received.

The problem was that the print quality and print fonts were completely different from, and substantially inferior to, what we saw at COMDEX. Fortunately, we had retained a sample printout from the printer at COMDEX and quickly notified Star of our displeasure. After first denying the problem then taking our names and telephone numbers, the people at Star assured us they were aware of the problem and action would be taken.

Approximately four weeks and three phone calls later, the new EPROM chips arrived. They were labeled version 1.3 and replaced version 1.2. The print is nearly identical to that of the COMDEX display.

Finally, we asked how long someone would have to wait in order to purchase an NX-10 with the new chip from a local computer store. The technical representative said Star has no plans to update this chip in the NX-10, and if you want the new chip you have to call Star and ask for it.

How do you tell which version your NX-10 has? Simply remove the ribbon cartridge and look through the plastic cover at the chip beside the two banks of DIP switches. The number is printed on the chip. Our advice is to call Star and ask what action to take for replacing the chip.

Dale S. Owens
Arthur J. Faske
Atlanta, GA ■

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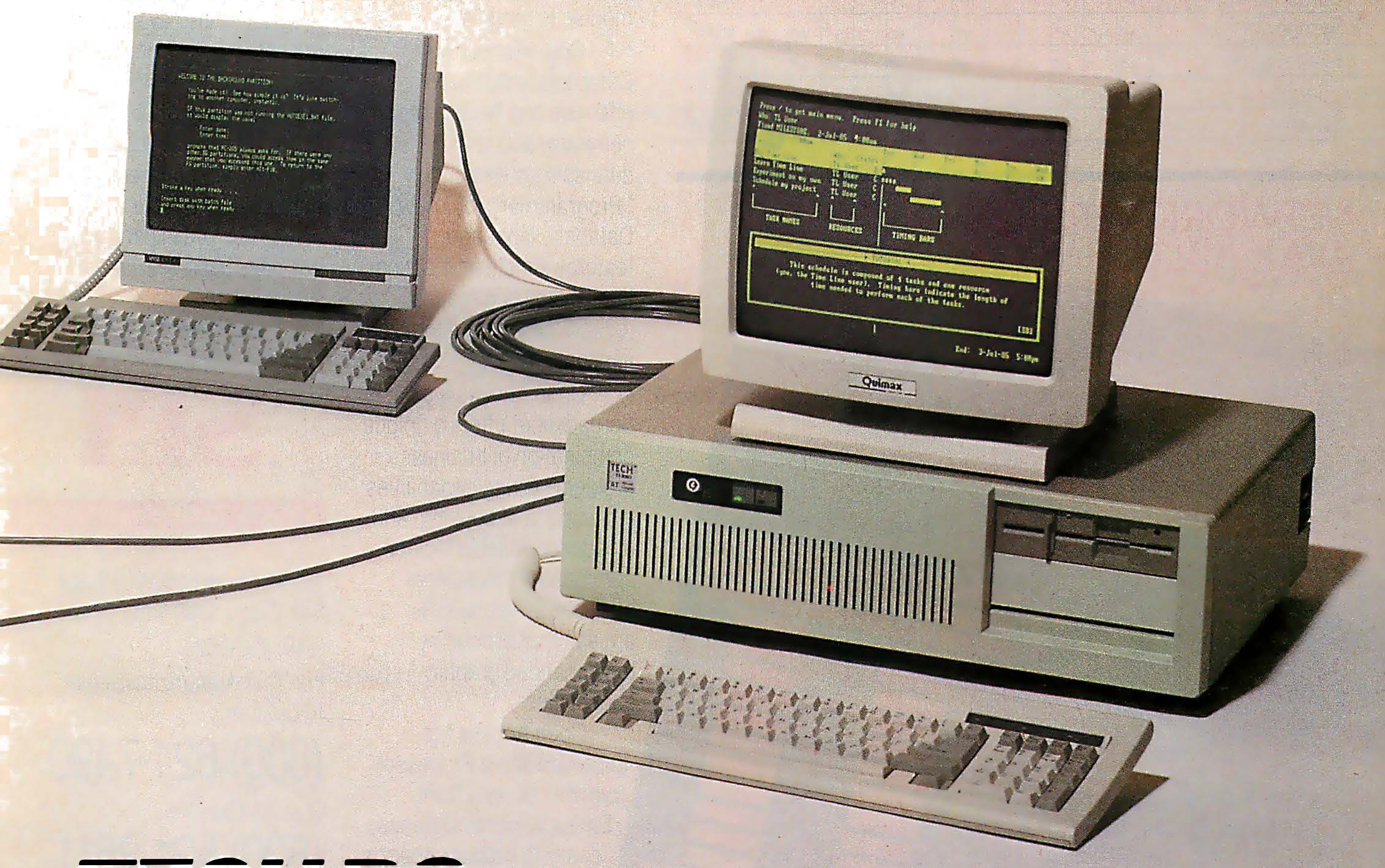
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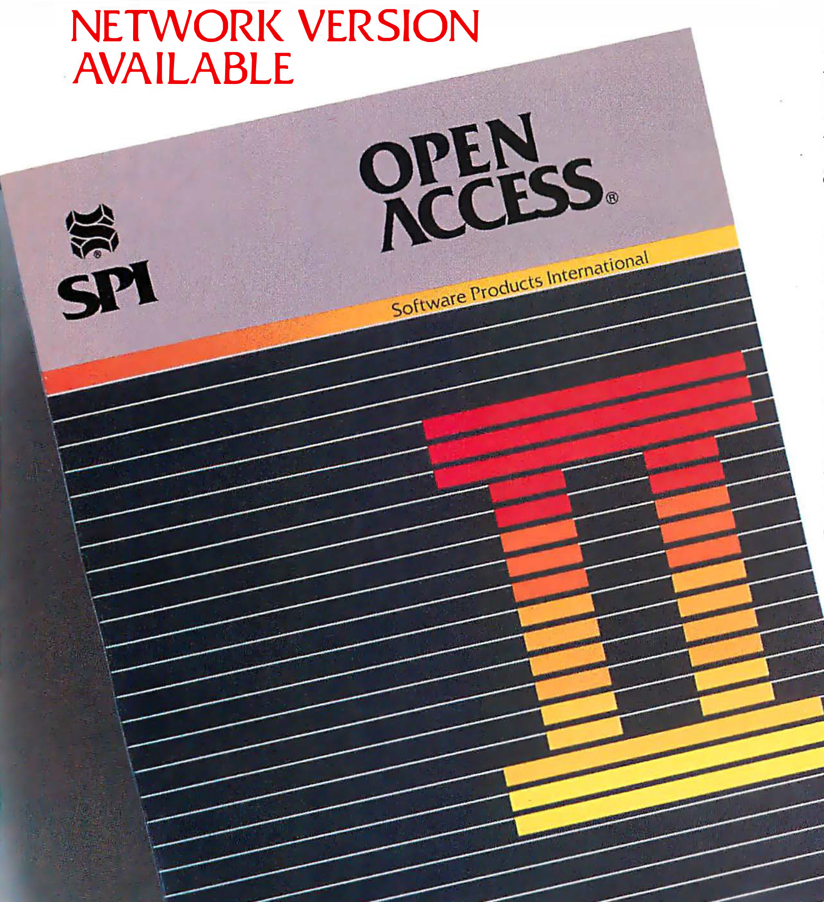
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Lotus 1•2•3	✓					✓		✓					495^{00}
Symphony	✓	✓	✓			✓		✓		✓	✓		695^{00}
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Enable	✓		✓			✓	✓	✓		✓	✓		695^{00}
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Open Access II is a new, super-program which can perform virtually every managerial and business task you'll ever need with performance and ease-of-use unheard of in the industry.

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Tandy Announces Five Systems

Tandy Corp. has introduced five computers, including two PC compatibles, an XT compatible, an AT clone, and a new version of the Color Computer.

The 1000 EX, a PC compatible which sells for $799, is a one-piece unit that resembles a wide Apple IIe. The EX's dual-speed 8088-2 runs at 7.16 or 4.77 MHz. The machine comes with one 5¼-inch floppy disk drive (an external 3½- or 5¼-inch floppy drive is optional); 256K bytes of RAM (expandable to 640K); three Plus expansion slots; and a new version of DeskMate, called Personal DeskMate, that has a graphical interface similar to Microsoft Windows. A monochrome monitor costs an extra $129.95; a color monitor, $299.95.

The Tandy 1000 SX, priced at $1199, a PC compatible that physically resembles the current Tandy 1000 and comes with two 5¼-inch floppy disk drives, 384K bytes of RAM, five PC-compatible expansion slots, DeskMate II, MS-DOS 3.2, and GW-BASIC. The computer uses the same processor as the EX. An external 3½-inch floppy disk drive costs $279; monitor options are the same as with the EX.

The first of the new 3000 series, the 3000 HL, uses an 80286 but is not fully compatible with the IBM PC AT. Tandy bills the $1699 machine as an XT compatible. The HL comes with 512K bytes of RAM, one 360K-byte floppy disk drive, and seven expansion slots. Hard disks are optional: a 20-megabyte unit costs $799 (plus $399 for the controller), and a 40-megabyte model costs $1799 (plus the $399 controller). A monitor is extra.



Tandy's 1000 EX, an 8088-based IBM PC compatible.



The Tandy 3000 HL, an XT compatible based on an 80286.

The 80286-based 3000 HD is an enhanced version of the AT-compatible Tandy 3000. Priced at $4299, the HD comes with a 1.2-megabyte floppy disk drive, a 40-megabyte hard disk drive, 640K bytes of RAM, 10 expansion slots, and a real-time clock. An optional parallel/serial adapter costs $79.95. A monitor is extra. The system will run XENIX System V, which will enable its memory to be expanded to 12 megabytes. Iomega Corp. says its new Beta 20 internal disk drive, which utilizes 20-megabyte 5¼-inch removable cartridges, is available as an option with the Tandy 3000 HL and 3000 HD.

The Color Computer 3, priced at $219.95, uses a 6809E processor with clock speeds of 0.87 or 1.7 MHz. It comes with 128K bytes of RAM (expandable to 512K) and a memory-management unit; 15- and 30-megabyte hard disks are available as extras. The machine displays 640 by 192 pixels, 80 characters by 24 lines, and four colors (out of a possible 64) on its CM-8 color monitor, which costs $299.95. The CoCo 3 can run the OS-9 Level 2 operating system, which gives it multitasking capability, and it's software- and hardware-compatible with the CoCo 2.

Tandy said it is discontinuing the Model 1200 and the old Tandy 1000. For more information, contact Tandy Corp./Radio Shack, 1800 One Tandy Center, Fort Worth, TX 76102, (817) 390-2129.

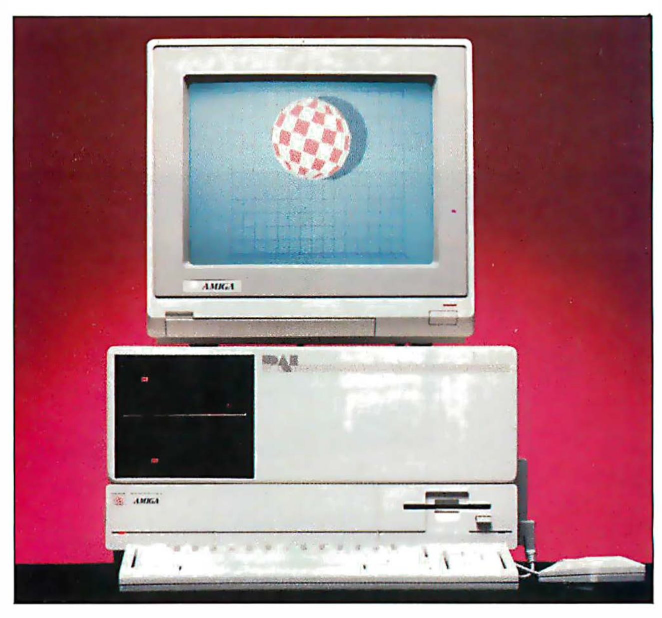
Inquiry 550.

(continued)

Amiga Expansion Chassis

The PAL System, an expansion chassis for the Commodore Amiga, enables you to add extra RAM, hard disks, and other options to the computer. In its base configuration, the unit sells for $1795. This includes 1 megabyte of RAM, which is located in the Amiga's reserve memory and can be autoconfigured; a battery-backed clock/calendar; and five DMA expansion slots that conform to the computer's 100-pin connector architecture. The chassis can hold three half-height drives and comes with a 200-watt power supply and fan.

Units with 20- and 45-megabyte hard disks are available for $3195 and $3995, respectively. Optional expansion cards include prototyping cards ($63) and a 2-megabyte RAM card ($1195) that can be upgraded to 8 megabytes. For more information, contact Byte by Byte Corp., 3736 Bee Cave Rd., Suite 3, Austin, TX 78746, (512) 328-2983.
Inquiry 551.



The PAL System, an expansion unit for the Amiga.

PFS Products Replaced with Series

The PFS:Professional series for IBM PCs and compatibles combines four individual programs for database management, word processing, spreadsheet analysis, and network capabilities. The programs work with other common office software, exchange data with each other, and read current PFS files directly.

PFS:Professional File, the database management program, has searching and sorting capabilities and offers global updating and reporting with up to 64 sorting levels, crosstab reports, and mailing labels. It requires 256K bytes of RAM and MS-DOS or PC-DOS 2.0 or higher and sells for $249.

PFS:Professional Write, the word processing program, offers a 70,000-word spelling checker with a thesaurus that has 20,000 keywords and 120,000 synonyms. Other features include an address book for mail merge, a line-drawing capability, single- and double-spacing of the same document, and block editing capabilities. It requires 320K bytes of RAM and MS-DOS or PC-DOS 2.0 or higher and is priced at $199.

PFS:Professional Plan, the spreadsheet program, combines recalculation ability and expanded spreadsheet size with analytical graphics. Its formulas are cell- as well as row/column-oriented, and its 94 formula keywords provide date, logic, mathematical, statistical, string, financial, if-then-else, and table lookup functions. Professional Plan requires 384K bytes of RAM and MS-DOS or PC-DOS 2.0 or higher. The list price is $249.

The series also includes PFS:Professional Network, which sells for $499, and enables multiple users to share Professional Series programs on a network. Requirements for Professional Network, as well as any of the series when used on a network, include 512K bytes of RAM and MS-DOS or PC-DOS 3.1.

For more information, contact Software Publishing Corp., P.O. Box 7210, Mountain View, CA 94039, (415) 962-8910.
Inquiry 552.

Two Token Ring Networks

3Com introduced a line of networking products, called TokenPlus, for connecting computers and workstations to a 3Com or IBM Token Ring network. The products include the RingTap ($95) and TokenPlus Cabling System, connectors and cables for hooking computers and workstations to a Token Ring network; prices for the trunk cables start at $50. The TokenLink Plus, an 80186-based adapter card that sells for $1095, provides 256K bytes of RAM for a computer or workstation connected to a network. The Token Connection ($1295), an expansion card for 3Com's 3Server, connects the file server to a Token Ring network and can act as a gateway between a Token Ring and an Ethernet network.

The company's 3+ network operating system software provides support for an Ethernet or Token Ring network; 3+NetConnect, a 3+ software module, connects Ethernet and Token Ring networks.

A TokenPlus Starter Kit, which contains three TokenLink Plus adapters, three RingTaps, and associated cabling, sells for $3755. For more information, contact 3Com Corp., 1365 Shorebird Way, P.O. Box 7390, Mountain View, CA 94039, (415) 961-9602.
Inquiry 553.

Univation's LANscape is an Ethernet-based local area network for IBM PCs and compatibles that provides links to Token Ring and UNIX systems. The 10-megabit-per-second network supports NETBIOS applications and uses Novell's Advanced Netware 2.0 operating system software, to which the company has added menu-driven diagnostics, monitoring, security, and software loading functions.

The system consists of the FS 2000 Series file server, which is based on a 10-MHz Intel 80286 and is available in capacities from 30 to 1200 megabytes. The unit can support up to 100 workstations. The network can also convert existing personal computers to file servers. A second component is the NC 516 Network Interface Card that connects computers, workstations, and file servers to Ethernet-

(continued)

THE TIME MACHINES



The Facit "C-line" includes the 400 cps, 15-color C7500 and the 250 cps, 7-color C5500

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The Facit C7500 and C5500 Matrix Printers not only handle a multitude of different applications. They permit instant switching from one application to another.

Printout options (including NLQ, multi-fonts and graphics), paper handling and all set-up parameters are changed in a matter of seconds using the "Yes" and "No" keys. Two entire parameter sets can even be pre-defined for instant selection.

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For a demonstration of how the Facit C7500 and C5500 boost the efficiency of your computer system, contact your nearest Facit representative.

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based networks. The NC 516 is equipped with 16K bytes of memory; the half-size card plugs into a single expansion slot in an IBM PC, XT, AT, or compatible.

The system's software includes Novell's Netware 2.0 with drivers for the Univation hardware, along with a Workstation Shell that the company says provides transparent access to file servers and supports DOS commands. An optional NETBIOS Emulator supports applications written for IBM's PC and Token Ring networks, and the UNIX software implements the TCP/IP protocol, which enables nodes on the network to communicate with UNIX or other TCP/IP-based systems.

A five-user system without a file server sells for $4665; with a 30-megabyte file server, $12,260. Contact Univation Inc., 1231 California Circle, Milpitas, CA 95035, (408) 263-1200.

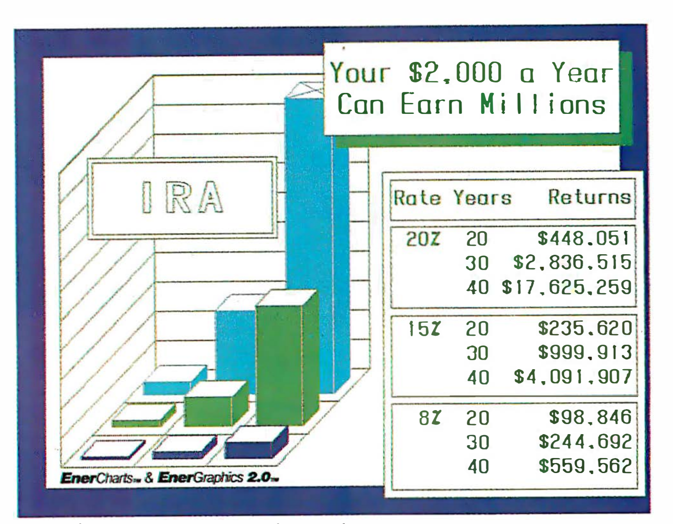
Inquiry 554.

Two- and Three-Dimensional Business Graphics

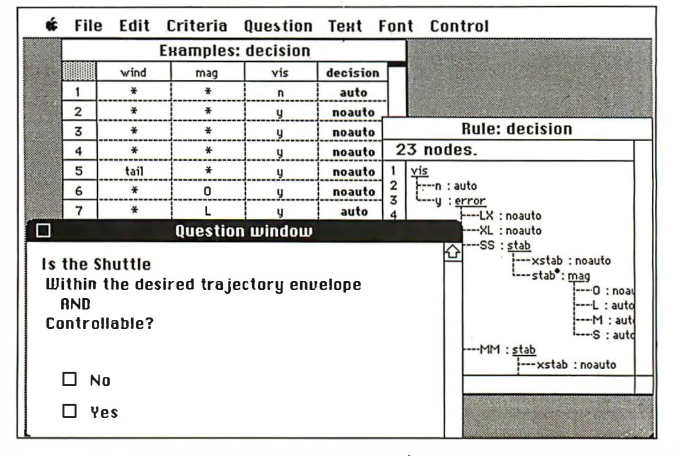
EnerCharts lets you create up to four bar, pie, or line charts on one screen in both two- and three-dimensional display. This business graphics program from Enertronics is compatible with over 35 printers and plotters, as well as with the Polaroid Palette for creating 35mm slides or photographs.

With EnerCharts you can customize your presentations by adding text, lines, and symbols; by changing font, size, color, slant, angle, or text; and by framing lines of text or the whole chart. On-screen prompts and pop-up help screens facilitate your editing.

The program runs on IBM PC XTs, ATs, and com-



EnerCharts presentation graphics package.



SuperExpert expert-system development interface.

patibles with at least 384K bytes of RAM running MS-DOS or PC-DOS 2.0 or higher. A color graphics card and monitor are required. EnerCharts is priced at $395. For more information, contact Enertronics Research Inc., #5 Station Plaza, 1910 Pine St., St. Louis, MO 63103, (314) 421-2771.

Inquiry 555.

80386-based Board Runs LISP

Gold Hill Computers and AI Architects have introduced an Intel 80386-based board for IBM PCs, XTs, ATs, and compatibles that runs the Golden Common LISP (GCLISP) Developer. The board, called the 386 HummingBoard, executes GCLISP five times faster than an IBM PC AT, the company claims, and is tailored to run large LISP applications.

The board's 32-bit 80386 processor runs at 16 MHz, and its directly addressable on-board memory is expandable to 24 megabytes with 1-megabit DRAMs or to 6 megabytes with 256K-bit DRAMs. The HummingBoard offers 32-bit data paths, 2K line high-speed cache memory, and multibuffered nonsuspensive I/O that enables it to compute in parallel with I/O operations, the company says. Also provided is an interface for sharing expanded memory with the computer's base processor, as well as optional support for Intel's 80287 or 80387 floating-point coprocessor.

The GCLISP 386 Developer that runs on the board includes a compiler, an interpreter, a GMACS editor, an on-line help facility, and a tutorial. With 6 megabytes of RAM and the 386 Developer, the HummingBoard costs $7000. For more information, contact Gold Hill Computers, 163 Harvard St., Cambridge, MA 02139, (800) 242-5477 or (617) 492-2071; or AI Architects Inc., One Kendall Square, Suite 2200, Cambridge, MA 02139, (617) 577-8052.

Inquiry 556.

Expert-System Development Package with Spreadsheet-like Interface

SuperExpert is an expert-system development package written by Donald Michie's group at the Turing Institute in Glasgow, Scotland.

With SuperExpert, you use a spreadsheet-like interface to enter and adjust information. You can enter a set of examples and let SuperExpert induce its own rules. And the query system is in natural language, so non-experts can understand it.

The program runs on IBM PCs, XTs, ATs, and compatibles that use PC-DOS or MS-DOS 2.0 or higher and have at least 256K bytes of RAM. An Apple Macintosh version is also available.

SuperExpert comes in three levels. The most powerful version is Level 3 ($1199), which lets you enter up to 1000 examples for each problem, up to 50 logical or integer attributes per problem, and up to eight levels of attribute subproblems. Level 2 ($599) lets

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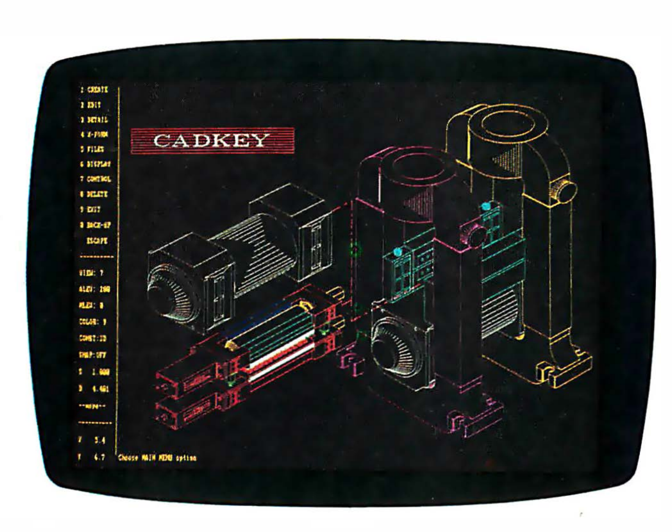


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you enter up to 200 examples per problem, up to 31 logical or integer attributes per problem, and up to four levels of attribute subproblems. With Level I ($199), you can enter up to 50 examples per problem, up to 31 logical or integer attributes per problem, and up to two levels of attribute subproblems.

For more information, contact Softsync Inc., 162 Madison Ave., New York, NY 10016, (212) 685-2080.
Inquiry **557.**



Enhanced CADKEY *design and drafting package.*

CADKEY Version 2.1

CADKEY, a computer-aided design and drafting system for IBM PCs and compatibles, is enhanced with new font files, entity grouping, and two- and three-dimensional cubic parametric splines. The new version supports high-resolution color graphics cards, color printers, and plotters.

Version 2.1 costs $2695. It requires a minimum of 512K bytes of RAM, a color graphics card, and an input device. For more information, contact Micro Control Systems Inc., 27 Hartford Turnpike, Vernon, CT 06066, (203) 647-0220.
Inquiry **558.**

Imagraph's Hi-Res Graphics Boards

Imagraph Corp. has released the Imaging series of high-resolution graphics controllers and a display adapter that works with the controllers. Based on the Hitachi HD-63484 Advanced Graphic Chip, most of the controllers consist of a single board that plugs into an IBM PC, XT, AT, RT, or compatible. The boards can display 8- to 24-bit two- and three-dimensional shaded images, as well as 8- to 12-bit gray shaded medical images.

The controllers are available with five display resolutions: 512 by 480, 640 by 480, 768 by 480, 768 by 576, and 1024 by 1024. Each resolution offers pixel depths ranging from 8 to 24 bits per pixel and provides a programmable palette of 16.8 million colors. All of the boards support a display refresh rate of 25/30 Hz interlaced; a 60-Hz noninterlaced refresh rate is also available.

Priced from $1995 to $3495, the boards feature a draw rate of 40,000 vectors per second and an image update rate of 5 million 8-bits/pixel per second; according to the company, this is equivalent to loading a 512 by 512 by 8 display buffer at 20 frames per second. Software drivers for Media Cybernetics' Halo and GSS's VDI are available.

The company's Single-Monitor Graphic Adaptor (SGA) board, which sells for $895, is compatible with the IBM Color Graphics Adapter. The SGA lets you combine a CGA monitor and high-resolution monitor in a single system and enables you to switch between CAD and CGA-compatible software via software commands. The board accepts RGB video signals; its horizontal scan rate is 50 kHz or 64 kHz. For more information, contact Imagraph Corp., 400 West Cummings Park, Suite 3600, Woburn, MA 01801, (617) 938-5480. 938-5480.
Inquiry **559.**

Portfolio Management on the Apple

Compusec is a portfolio management program for the Apple II family that sells for $79.50. It performs 18 functions automatically, according to the manufacturer. Some of the functions include calculating compound growth rates between any two earnings-per-share figures, calculating years required to earn back market price, showing daily volume, and recording the date and time of the quote.

Compusec requires one disk drive, but you do not need a printer, as the program gives you the option of viewing reports instead of only printing. For more information, contact Compunetics Inc., 6601 River Rd., Bethesda, MD 20817, (301) 320-5820.
Inquiry **560.**

Webster's New World Writer

A word processor, thesaurus, and spelling checker are what you get with Webster's New World Writer. The on-line thesaurus has more than 120,000 synonyms and phrases. The word processor offers a graphics key, so you can draw lines and boxes around your text, and another key recovers copy you've accidentally deleted.

You'll need an IBM PC, XT, AT, or compatible with at least 256K bytes of RAM and MS-DOS or PC-DOS 2.0 or higher (3.0 with an AT). Two floppy disk drives or one floppy and one hard disk drive are required, along with an 80-column color or monochrome display. With an IBM Enhanced Graphics Adapter, the program can support a 43-line display. The list price is $150. Contact Simon & Schuster Computer Software, Gulf & Western Building, One Gulf & Western Plaza, New York, NY 10023, (212) 333-2882.
Inquiry **561.**

WordPerfect Enhanced

WordPerfect Corp.'s WordPerfect version 1.1 includes an install program, a 50,000-word speller, and support for proportional printing. The word speller checks a word, page, or document and lists a variety of spellings to help you find the correct one.

WordPerfect 1.1 runs on the Apple IIe and IIc with 128K bytes of RAM. The price remains at $179. Contact WordPerfect Corp., 266 West Center, Orem, UT 84057, (801) 227-4020.
Inquiry **562.**

(continued)

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–William G. Wong, *BYTE*, August 1986.

"Let's C is a thoroughly professional C environment loaded with tools and programming utilities...another fine Mark Williams product."
–Christopher Skelly, *COMPUTER LANGUAGE*, February 1986

"The performance and documentation of the $75 Let's C compiler rival those of C compilers for the PC currently being sold for $500... highly recommended..."
–Marty Franz, *PC TECH JOURNAL*, August 1986

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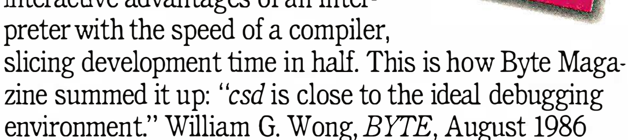
Let's C Benchmark Done on an IBM-PC/XT, no 8087.
Program: Floating Point from BYTE, August, 1983.

Exec Time in Seconds	
Let's C	134
MS 4.0	147

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Inquiry 183

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SYSTEMS

S-100 Board Based on 80186

The Thunder Plus 80186, an S-100–bus single-board computer, runs on an 8-MHz 80186 microprocessor. The board is equipped with 1 megabyte of zero-wait-state memory, two RS-232C serial ports, a parallel port, and a floppy disk controller that can control 8-, 5¼-, and 3½-inch drives. Available as options are a 10-MHz processor and an 8087 math coprocessor.

The board, which sells for $1195, comes with Concurrent DOS. For CAD applications, the company also sells fully configured systems based on the Thunder Plus. Contact Lomas Data Products Inc., 182 Cedar Hill St., Marlboro, MA 01752, (617) 460-0333.
Inquiry **563.**

XT Compatible with Voice Control

Microphonics Technology has announced the VOX/COM PC, an IBM PC XT–compatible computer that incorporates the company's Pronounce voice-control system. The Pronounce system gives you the ability to operate PC-DOS and MS-DOS software using spoken commands.

Priced at $2495, the computer operates at speeds from 4.77 to 14 MHz. Standard features include a 20-megabyte hard disk and a 5¼-inch floppy disk drive. A monochrome graphics display adapter, AT-style keyboard, and internal Hayes-compatible 1200-bps modem are also included. For $199, you can upgrade the modem to 2400 bps.

The computer provides communications functions such as automatic redialing of busy numbers, password security, call progress tone detection, and an electronic mailbox buffer. A Touch-Tone decoder enables the computer to accept data input from Touch-Tone phones. With an optional speech synthesizer connected to the computer's audio input jack, the system can read messages to callers at remote locations. Using the concurrent software provided, you can create voice macros that perform like keyboard macros but instead are invoked with words.

Contact Microphonics Technology Corp., 25 37th St. NE, Suite B, Auburn, WA 98002, (800) 325-9206.
Inquiry **564.**

AT Compatible Equipped for Color

MicroDirect has introduced the SST 286/C, an IBM PC AT–compatible computer with full color capabilities. Priced at $4786, the 6- or 8-MHz machine comes with an EGA-compatible graphics adapter, an NEC Multisync color monitor, and an NEC P56 XL 24-pin dot-matrix color printer.

Standard features of the base model include 1 megabyte of RAM, a 1.2-megabyte floppy disk drive, and a 30-megabyte hard disk drive. Two serial ports, a parallel port, and eight expansion slots are also standard.

The computer is bundled with PC-DOS 3.1; also included in the base price is a one-year warranty and on-site service contract. According to the company, the computer is compatible with software and networks designed for the IBM PC AT. Contact MicroDirect Inc., 180 Bent St., Cambridge, MA 02141, (617) 494-5300.
Inquiry **565.**

Multibus Board Runs on NEC V30

Comark's MV30/35 is an 8-MHz Multibus single-board computer that features a NEC V30 microprocessor and up to 1 megabyte of dual-ported parity-checked RAM. The system provides sockets for an 8087 floating-point coprocessor, an 8089 DMA controller, and four 28-pin EPROMs (up to 256K bytes). Its I/O support includes two 16-bit-wide SBX connectors and programmable parallel and serial ports.

Other standard features include three independent counter/timers, a programmable interrupt controller, a programmable PROM disable, on-board status LEDs, and a 4-bit page register. The MV30/35 is compatible with Intel's iSBC 8630 and iSBC 8635; it is also available with Concurrent DOS and a 10-MHz processor.

With 128K bytes of RAM, the board costs $1067; with 256K bytes, $1139; and with 1 megabyte, $1355. For more information, contact Comark Corp., 93 West St., P.O. Box 474, Medfield, MA 02052, (617) 359-8161.
Inquiry **566.**

PERIPHERALS

I/O Interface for Apple IIe

The Simple Interface IIe System lets you connect Apple IIe computers to a variety of test and measurement devices. Priced at $46.95, the system consists of a plug-in card and external interface unit and optional special-function conditioner boards.

The interface enables you to connect up to eight switches and eight loads, including lamps, relays, and small motors. The card plugs into a slot in the computer; connections to various devices are made through signal-conditioning circuits that are housed in a cartridge case connected to the card with a cable. The unit can be operated with BASIC or machine language programs and is accompanied by a sample program disk.

Available plug-in conditioning boards include opto-isolated I/O conditioners, terminal strip boards, relay output boards with up to 7-amp control capability, 3-channel 8-bit A/D converters, and temperature sensors. Contact Proteus Electronics Inc., RD 2, Spayde Rd., P.O. Box 693, Bellville, OH 44813, (419) 886-2296.
Inquiry **567.**

Hard Disks for Laptop PCs

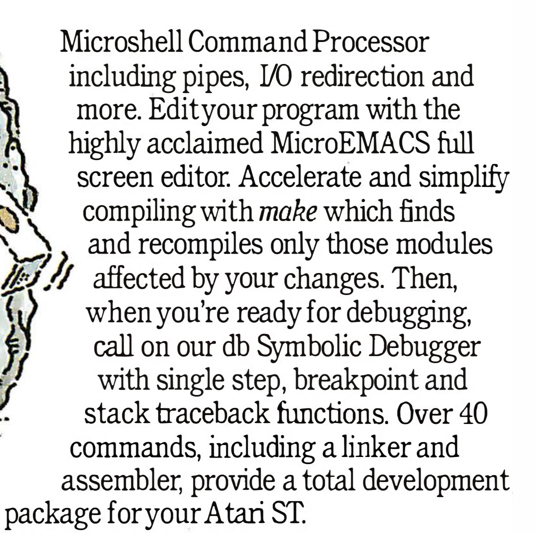
The Diskit Portable Series of hard disk drives works with the Zenith Z-171, Kaypro 2000, and IBM PC Convertible portable computers. The series features an auto-booting 20-megabyte hard disk with battery backup and an average access time of 65 milliseconds.

The Z-171–compatible drive plugs into an expansion port on the computer and works on AC power or with an optional DC adapter. Its controller lets you add a second drive or drives with a capacity of up to 180 megabytes. The Kaypro-compatible drive works with 100/

(continued)

MARK WILLIAMS C. AN ENLIGHTENING DEVELOPMENT FOR ATARI ST USERS.

If you've tried your hand at developing applications on the Atari ST, you know the problem. Programming tools aren't only hard to come by, they're hard to use. One might even say primitive. But now for some enlightening news: you can have all the power, portability and versatility of the C language from a leader in professional C programming tools, Mark Williams.



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The Mark Williams C compiler produces fast, dense code and supports the complete Kernighan & Ritchie industry standard C. You'll have access to GEM's AES and VDI libraries for programs using graphics, icons and the Atari mouse. And Mark Williams C lets you take advantage of the full 16 megabytes in Atari's 68000 microprocessor.

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- Complete UNIX-compatible libraries allow easy portability to and from UNIX development environment.
- Over 300 Atari-specific routines
- One-step compiling, linking with cc command
- English error messages
- Lint-like error checking

Microshell Command Processor, powerful UNIX style shell includes I/O redirection, pipes, command substitutions

MicroEMACS Full Screen Editor with commented source code included

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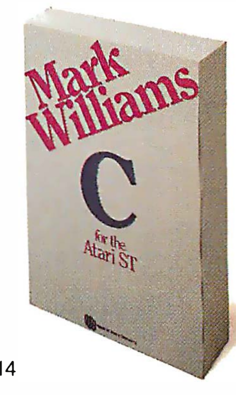
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1430 West Wrightwood, Chicago, Illinois 60614

Inquiry 184

AT Power, Toshiba-Style.



The Toshiba T3100.

Try tucking this into a drawer when you're done! Until now, you had to be tied to your desk in a tangle of cables and hardware to get AT power. Toshiba's T3100, on the other hand, puts AT performance anywhere you want.

Toshiba technology improves on AT functionality: The T3100 gives you the power of an IBM® PC-AT™ in a lean, 15-pound computer that looks superb on your desk, and slips into a drawer when you don't need it. Take it home, take it to a meeting, take it around the world—wherever your work takes *you*.

Don't let its size fool you.

The T3100 is less than a third the size of the Compaq™ Portable II, yet every bit as powerful. It uses the same 80286 microprocessor as the AT, and is fully IBM-compatible, so you can share data with the other desktop computers in your office. The T3100's 10MB internal hard disk gives you ample storage for sophisticated applications. A dual-voltage power supply lets you plug in and go to work just about anywhere in the world. And Toshiba built in an advanced gas plasma screen, to give you the clarity and brightness of a CRT display—without the bulk.



Compact is as compact does: The T3100 is less than a third the size of the Compaq Portable II.

More memory for more applications.

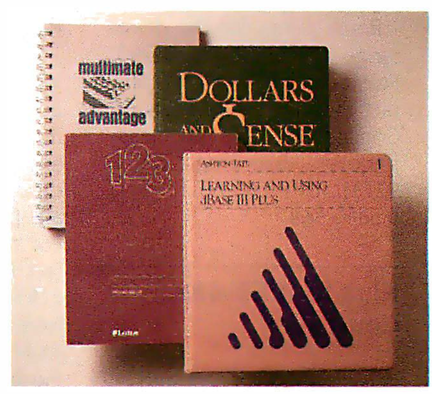
The T3100's full 640KB RAM lets you work with the most popular IBM PC/XT™ and AT software: Integrated financial and analysis programs, large spreadsheets, lengthy documents, electronic filing and more. A built-in 720KB diskette drive handles the new industry standard 3½" diskettes. Each IBM-compatible pocket-sized disk holds *twice* as much information as a conventional 5¼" diskette! And you can easily transfer data to and from other desktop computers using Toshiba's optional external 5¼" diskette drive.

Specifications:

- IBM PC-AT compatible
- 80286 processor, running at 8MHz or 4 MHz
- 640KB RAM, extendable to 2.6MB
- Built-in 10MB hard disk
- Built-in 720KB 3½" diskette drive
- MS-DOS 2.11 operating system
- High-resolution gas plasma display
- IBM Color Graphics Adapter (CGA) compatible
- 80 × 25 character display
- 640 × 400 bit-mapped graphics display
- RGB, parallel, serial and external diskette drive ports
- Carrying case, MS-DOS,™ BASIC included
- Full-sized 81-key keyboard
- 110/220 VAC switch-selectable power supply
- 12.2" W × 3.1" H × 14.2" D
- All this—and only 15 pounds

"Big" system expansion options.

Like any full-function desktop system, the T3100 grows with your computing needs. Toshiba offers a full line of internal and external options, including an expansion chassis with 5 IBM-compatible slots, and an internal 300/1200 bps Hayes®-compatible modem.



Software, everywhere: The T3100 runs the most popular applications written for the IBM PC/XT and AT.

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PERIPHERALS

220-volt AC power or with a cigarette lighter adapter.

Retail prices for the drives range from $1095 to $1295. For more information, contact Systems Peripherals Consultants, 9747 Businesspark Ave., San Diego, CA 92131, (619) 693-8611.
Inquiry 568.

Plug-in IEEE-488 Controller

Designed for test and measurement applications, the BusMate instrument controller enables computers with an RS-232C or RS-422 serial port to control up to 14 instruments. The $695 unit contains firmware that enables it to operate as an IEEE-488 bus controller and run programs written in BASIC, FORTRAN, Pascal, and other languages. The controller accepts the instructions you write and generates the appropriate IEEE-488 control commands and codes; a demonstration disk and instruction manual are packaged with the unit. For more information, contact ICS Electronics Corp., 2185 Old Oakland Rd., San Jose, CA 95131, (408) 263-4844.
Inquiry 569.

Peachtree's Hard Disk for the Mac Plus

Peachtree Technology's S-20Plus hard disk drive offers 20 megabytes of storage capacity for the Apple Macintosh Plus. The external drive connects to the computer's SCSI port and provides a controller and self-diagnostic capabilities. Retail price for the drive is $1395. For more information, contact Peachtree Technology Inc., 3120 Crossing Park, Norcross, GA 30071.
Inquiry 570.

Centronics Laser Printer

Centronics announced its first laser printer, the PagePrinter 8, which prints at a rate of eight pages per minute. The standard model comes with 256K bytes of memory, which enables you to print 3 square inches of graphics at a resolution of 300 by 300 dots per inch. To print a full page of graphics at 300 by 300 dpi, you can add a memory board that upgrades the printer's RAM to 1.5 megabytes.

The $2495 printer offers a choice of three interfaces—parallel, serial, and IEEE-488—that come on plug-in modules. The resident font is Courier 10; other fonts and character sets are available on plug-in cards. Standard emulations include Diablo 630 and Epson FX-80, with Diablo 630 ECS, IBM ProPrinter, and IBM Graphics Printer emulations available as options. Contact Centronics Data Computer Corp., One Wall St., Hudson, NH 03051, (603) 883-0111.
Inquiry 571.

ADD-INS

Boards Combine 2400-bps Modem, Display Adapter

Emulex's Persyst Division is selling enhancement boards for IBM PCs, XTs, ATs, and compatibles that combine communications and display capabilities on a unit that holds a 2400-bps modem, a display adapter, a parallel port, and a clock/calendar. Modem Combo cards are offered in two versions: the Modem Mono Combo, which provides a monochrome display adapter and lets your machine run software written for IBM's CGA, and the Modem Color Combo, an IBM-compatible color display adapter.

The async full-duplex modem is compatible with the Hayes Smartmodem and responds to the AT command set. The serial port is dedicated to the modem. Communications parameters are set using software. Because no jumpers are needed to set parameters, you can configure your computer using a batch file, Persyst says. Both modems have a parallel printer port that's compatible with a Centronics or Dataproducts interface. You can configure the bidirectional I/O port for custom devices that require two-way communications.

The monochrome version supports a 7- by 9-dot character in a 9- by 14-dot field and provides an 8-character by 25-row display. The color display adapter supports a 7- by 7-dot character in an 8- by 8-dot field. Both boards include IBM's 256-character set and work with a light pen.

Suggested list price for each Modem Combo card is $899. Contact Emulex Corp., 3545 Harbor Blvd., P.O. Box 6725, Costa Mesa, CA 92626, (714) 662-5600.
Inquiry 572.

Recoverable RAM Disk for Mac Plus

MacMemory's MaxSave recoverable RAM-disk system for the Macintosh Plus combines a card with RAM disk and print spooler software. In the event of a system crash, the company says, you only have to press the computer's reset button to recover the RAM disk's data; MaxSave intercepts the reset signal to preserve RAM disk information while rebooting.

The unit plugs into the Mac's ROM sockets without modification and uses the machine's internal memory. It can fully use 1-megabyte or larger memories.

The system's MaxRAM software automatically creates the RAM disk when you boot up the machine and copies your files to it. MaxRAM works with hard disks, 400K- and 800K-byte drives, and memory sizes from 512K bytes to 4 megabytes. MaxPrint, a desk-accessory print spooler, handles graphics as well as text. It enables you to spool several documents at once and change applications while printing. It can also spool to a hard disk.

The MaxSave System sells for $119. You can buy MaxRAM and MaxPrint as a separate package for $49.95. Contact MacMemory Inc., 473 Macara Ave., Suite 701, Sunnyvale, CA 94086, (408) 773-9922.
Inquiry 573.

Card, Software Let PCs Read Apple Disks

The Matchpoint-PC package, which includes a card and software, lets IBM PC users read from and write to Apple DOS, ProDOS, SOS, and CP/M disks. The half-size card fits in a PC expansion slot and in-

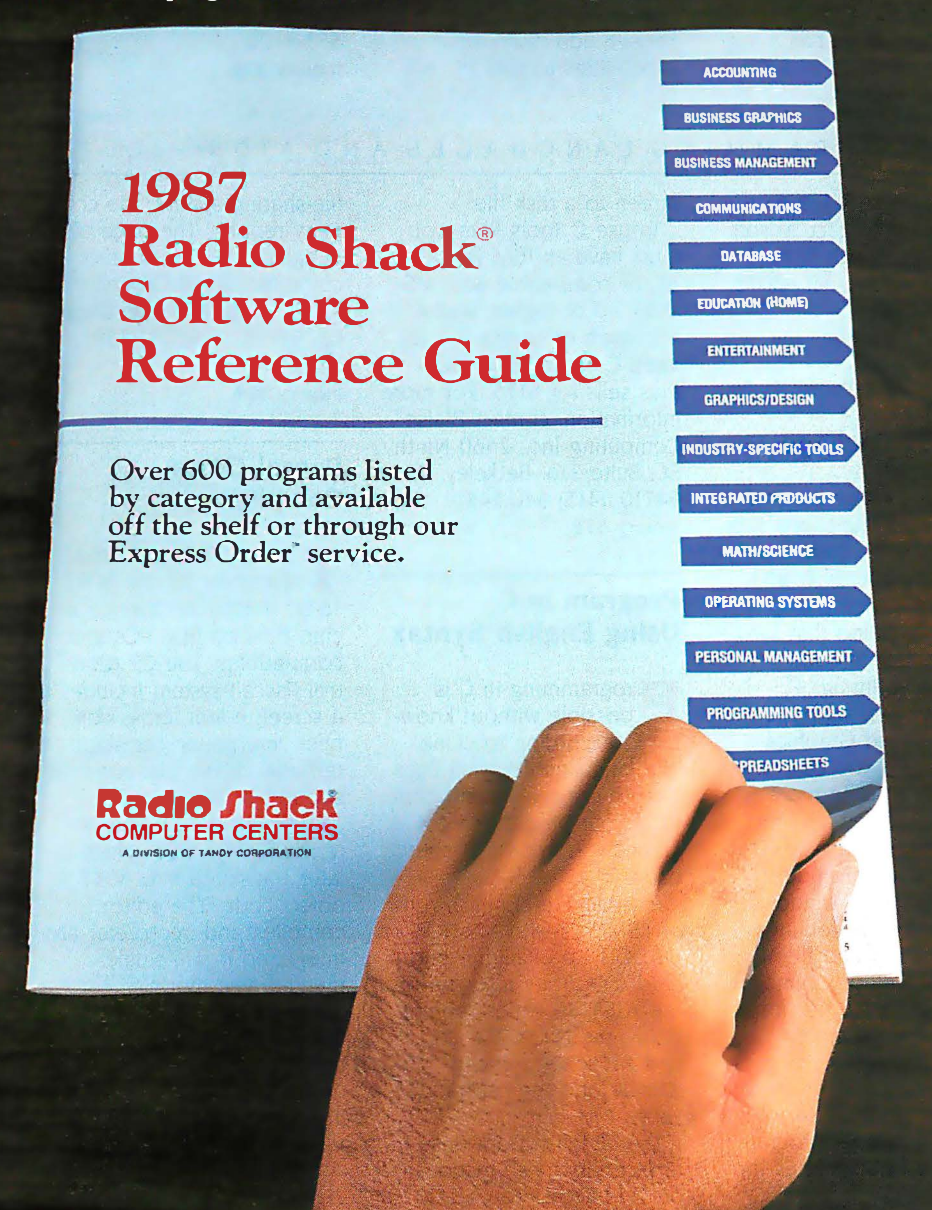
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ADD-INS

cludes connectors and cable to hook it to the floppy disk drives.

Besides Matchpoint software, the package comes with UniForm-PC (version 2), which makes the computer read CP/M disks as if they were PC-DOS disks. Used with the Matchpoint board, it also lets you use Apple SoftCard and North Star CP/M disks on a PC.

MatchPoint-PC retails for $195. Contact Micro Solutions Inc., 125 South Fourth St., DeKalb, IL 60115, (815) 756-3411.
Inquiry 574.

Memory Upgrade for Atari 520ST

EZRAM 520, a 512K-byte memory upgrade for Atari's 520ST, raises RAM to 1 megabyte. Terrific Peripherals says the kit is designed for simple installation. You make the 13 solder connections on a template, not on the motherboard. The kit comes with a high-speed digital signal cable, and the memory banks are fully decoupled with high-frequency ceramic capacitors.

The upgrade kit has a suggested retail price of $199 and is covered by a 180-day warranty. Contact Terrific Peripherals, 17 St. Mary's Court, Brookline, MA 02146, (617) 232-2317.
Inquiry 575.

Multiuser Converter Adds Serial Ports

Control Electronics has a line of multiuser boards compatible with Software Link's MultiLink and with UNIX-based systems. The MultiSerial-4 and MultiSerial-8 add multiuser capabilities to IBM PC ATs and compatibles through the use of fully wired 25-pin RS-232C asynchronous ports. Each serial port can support either a modem or a terminal. The ports are fully programmable for start bits, stop bits, parity bits, and data-transmission rate. You can address as many as 64 ports.

The MultiSerial-4 port board lists for $259; MultiSerial-8 lists for $359. Contact Control Electronics Inc., 37450 Enterprise Ct., Farmington Hills, MI 48018, (313) 553-3400.
Inquiry 576.

SOFTWARE • PROGRAMMING LANGUAGES AND AIDS

AC/FORTRAN Compiler for the Atari 520ST and 1040ST

Absoft Corp. designed its ANSI FORTRAN 77 compiler with debugger to run mainframe programs downloaded to an Atari 520ST or 1040ST. AC/FORTRAN is a disk-based compiler, requiring 46K bytes of RAM, which enables you to develop large programs on a standard 256K-byte machine.

Native object code for the MC68000 is generated by AC/FORTRAN. Development tools support of overlays and virtual arrays and dynamic linking of programs at run time. Included are a full-screen source-level symbolic debugger, linker, library manager, single- and double-precision floating-point software, complex number support, and a C interface. According to Absoft, there is no limit on code or data size.

AC/FORTRAN is source-compatible with Microsoft's FORTRAN compiler for the Macintosh and AC/FORTRAN for the Amiga. The program is not copy-protected and sells for $199.95. For more information, contact Absoft Corp., 4268 North Woodward, Royal Oak, MI 48072, (313) 549-7111.
Inquiry 577.

C Library Support Package

C Tools Plus consists of over 200 functions supplied in source code that run on the Microsoft and Lattice 3.0 C compilers. A utility is included that formats the source code listings for printing.

The program supports the IBM Enhanced Graphics Adapter, and you can create applications using more than one display adapter and monitor at a time. Other features include screen handling, windows, interrupt service routines, DOS directory and file handling, memory management, and string functions.

You can write memory-resident routines by accessing DOS functions from within an interrupt service routine. A sample program is provided that dumps the screen to a disk file.

To use C Tools Plus, you must have an IBM PC, XT, AT, or compatible with MS-DOS 2.0 or higher, and a Microsoft or Lattice 3.0 (or later) C compiler. C Tools Plus sells for $175. For more information, contact Blaise Computing Inc., 2560 Ninth St., Suite 316, Berkeley, CA 94710, (415) 540-5441.
Inquiry 578.

Program in C Using English Syntax

Programming in C is possible without knowing C, according to cLine. The language cEnglish uses English-like syntax and compiles your programs into Lattice C–compatible source code.

Programs in cEnglish run on IBM PCs with MS-DOS or PC-DOS 2.0 or higher and a hard disk. They also run on the AT&T 3B series running UNIX, the ITT XTRA, XL, and XP series running XENIX, and the DEC VAX series.

The cEnglish Data Base Interface Library's functions provide access to C-ISAM and compatibility with PC-NET and any other MS-NET file-sharing system, the company reports. The price of cEnglish is $795. Contact cLine Inc., 3550 Camino del Rio N, Suite 208, San Diego, CA 92108, (619) 281-5593. 281-5593.
Inquiry 579.

Pascal Cross Compiler

The CP-97 Pascal Cross Compiler for the 8097 16-bit microcontroller on a chip runs on IBM PCs and compatibles. The CP (Control Pascal) system includes a screen editor, cross compiler, interpreter, translator, terminal driver, and run-time support software.

Compiler output is in intermediate p-code, which is later translated into 8097 object code. The editor, compiler, and interpreter are integrated into a single menu-driven module.

The CP-97 system costs $200. Contact Allen Systems, 2151 Fairfax Rd., Columbus, OH 43221, (614) 488-7122.
Inquiry 580.

(continued)

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SOFTWARE • SCIENTIFIC AND ENGINEERING

TUTSIM Linked with FFT

FANSY is a program that analyzes the time response of a TUTSIM model on the IBM PC and compatibles. Developed at the University of Waterloo in Canada, FANSY stands for frequency analysis and synthesis.

TUTSIM is a computer simulation program that uses block diagrams to implement system equations term by term. You can vary the model design, add or delete blocks, change interconnections, and vary parameters and values at any time during a simulation. Conversion of a filed time response of a TUTSIM simulation to the frequency domain is done by FFT routines.

FANSY requires the IBM Color Graphics Adapter to show gain and phase plots versus frequency. Two versions of FANSY come on one disk: Both run on the IBM PC, but one is for the PC with an 8087/80287 coprocessor. FANSY is priced at $185. For more information, contact Applied i, 200 California Ave., Suite 214, Palo Alto, CA 94306, (415) 325-4800.

Inquiry 581.

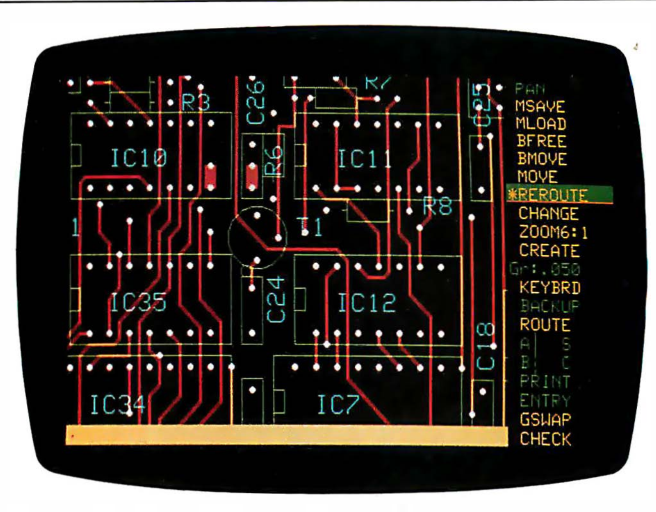
Data Acquisition and Display on the Apple IIe and IIc

You can perform numerical operations on large sets of data on an Apple IIe or IIc with Vidichart-IV. The program enables you to define four data sets of up to 8192 values, each with its own scaling information that transforms the raw data into physical values in any units you choose.

On a high-resolution screen (560 by 192 pixels), you can display up to four windows of any size at any position. Each plot is labeled with numbers and text labels along the axes, and you can superimpose additional labels anywhere on the screen. You can plot or overlay any data set in any window, using dotted or solid lines or filled-area plots in white on a black background. In any window you can shift, compress, or expand the *x* or *y* scale, or you can zoom in on a region framed by the cursors. The cursor displays any value along a curve.

You can enter data from the keyboard, disk, or joystick, and output data to the screen, disk, or printer. Menus list options, and online help screens are available for any commands. The program includes utility, numerical, normalization, baseline definition, and peak integration commands. You must have an Apple IIe with a 64K-byte extended 80-column card or an Apple IIc. The price is $165. Contact Interactive Microware Inc., P.O. Box 139, State College, PA 16804-0139, (814) 238-8294.

Inquiry 582.



EE *Designer circuit design* CAD *package.*

EE Designer Enhanced

Visionics announced enhancements to its EE Designer CAE/CAD software for circuit design and printed circuit board layout. It now supports the Enhanced Graphics Adapter in 640 by 350 resolution in 16 colors. And it supports the bus version of the Microsoft mouse and compatibles as well as the serial mouse.

The $975 package runs on IBM PCs, XTs, ATs, and compatibles. Contact Visionics Corp., 1284 Geneva Dr., Sunnyvale, CA 94089, (800) 225-5669; in California, (408) 745-1551.

Inquiry 583.

Three-Dimensional Graphics on the Atari ST

CAD-3D is a computer-aided design program for the Atari 520ST and 1040ST. It can create solid-model animation sequences and three-dimensional scenes in color, with shading from adjustable multilight sources.

The software uses Digital Research's GEM interface and comes with four sample scenes. It is priced at $49.95. For more information, contact Antic Publishing Inc., 524 Second St., San Francisco, CA 94107, (415) 957-0886.

Inquiry 584.

Mainframe Statistics Package on the AT&T UNIX PC

P-STAT has been converted from mainframe software to a package that runs on the AT&T UNIX PC (Model 7300). It manages and analyzes data by combining data and file management, data display, statistical analysis, survey analysis, and report-writing capabilities.

P-STAT features an on-line help facility, an interactive editor, flexible data entry and validation, relational database capabilities, macros, and statistical procedures. The program consists of a single source file of about 300,000 lines of FORTRAN code and costs $995. For more information, contact P-STAT Inc., P.O. Box AH, Princeton, NJ 08542, (609) 924-9100.

Inquiry 585.

Uni-CAD for MS-DOS Systems

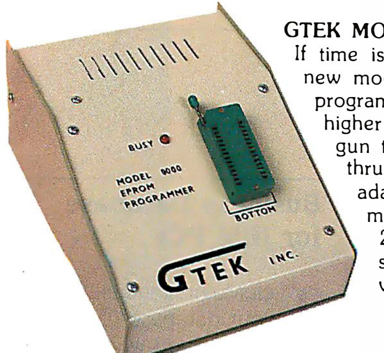
Xysys announced that Uni-CAD, a computer-aided design program, is now available for IBM PC XTs, ATs, and compatibles. Uni-CAD supports systems with Color Graphics Adapters or Enhanced Graphics Adapters and one monitor, or it will run with two screens.

Uni-CAD requires PC-DOS or MS-DOS 2.1 or higher, 640K bytes of RAM, a graphics adapter, and a plotter. Prices start at $1695. Contact Cyber/Source, 24000 Telegraph Rd., Southfield, MI 48034, (313) 353-8660.

Inquiry 586.

(continued)

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MODEL 7228 (E)EPROM/MPU PROGRAMMER The standard by which other other programmers are judged. With thousands in the field, the time proven *7228* has become our most popular programmer. Intelligent algorithms standard. Programs a 2764 in one minute. Supports devices thru 512K, mpu's, eeproms, cmos. NO personality modules. Price **$599**



MODEL 7956 GANG (E)EPROM/MPU PROGRAMMER
The 7956 can program eight 2764's in one minute using intelligent algorithms. Standard support thru 512K, eeproms, cmos, mpu's. A must for production emvironments. Available in stand alone only configuration for **$979**
or with RS-232 interface for **$1099**

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MODEL 705 Motorola 68705 family programmer. Transfers object code to 28 and 40 pin mpu's. Single key stroke operation. **$299**

MODEL 7324 PAL PROGRAMMER The 7324 has a built-in compiler. It supports 20 and 24 pin pals by MMI, NATIONAL, and TI, including the new shared product parts 20S10, 20RS10, 20RS8, 20RS4. It operates stand alone or via RS-232 with PALX communications package. Functionally tests parts after programming and securing. External compilers are supported thru JEDEC and AHS object formats. **$1499**

MODEL 7322 Same as 7324 but no stand alone capability. **$1249**

UTILITY PACKAGES

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MODEL 481/482/483 8048family adapters **$98**
MODEL 511/512 8051 family adapter **$174**
MODEL 755/756 8755 adapter ... **$135**

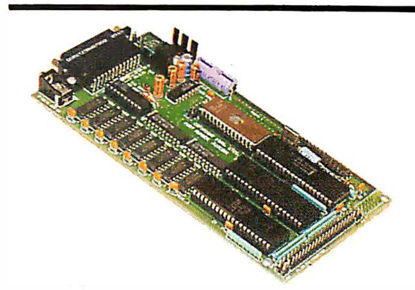
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If you are a CPM user who wants to convert to MSDOS or PCDOS or a PC user who would like access to the thousands of CPM programs in existance, here is the perfect solution to the problem: CPMulator from GTEK.
CPMulator is the only field proven emulator which emulates the complete Z-80 instruction set. Terminal attribute emulation is Televideo, Lear Siegler, or the ANSI standard. CPM .COM programs reside under PCDOS and are executable under PCDOS as well as 8086 programs.
Comes complete with COPYCPM, a disk conversion utility which allows transferring data and programs to and from 54 different CPM disk formats. Free CPM utility programs are also included.
For speed use the 8080 CPMulator along with the NEC V20 or V30 chip.

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8080 CPMulator, DR5PC-EMV205 **$ 99.00***
Z80, 8080 CPMulator, DR5PC-EMZV205 .... **$149.00***
*Requires NEC V20 or V30.
NEC V20 (5Mhz) .... **$ 12.00**



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SOFTWARE • BUSINESS AND OTHER

Design and Paint with Atari ST

The GEM-based package PaintPro lets you design and paint on the Atari ST. It supports up to three active windows and comes with free-form sketching, lines, circles, ellipses, boxes, fill, copy, move, spray, zoom, undo, and text capabilities.

PaintPro works with most dot-matrix printers, the company reports, and it works with either monochrome or color systems.

The price of the program is $49.95. For more information, contact Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510, (616) 241-5510.

Inquiry 587.

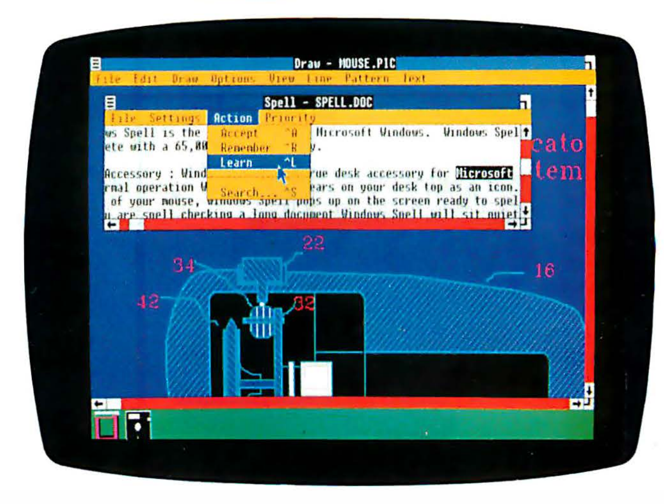
Amortization in C

MicroCost Software announced Effortless Interest, an amortization program written in C that runs on 64K-byte RAM CP/M-80 systems or IBM PCs and compatibles with PC-DOS or MS-DOS 2.0. The company reports that the program is accurate up to 14 significant digits.

With Effortless Interest, you select daily, weekly, biweekly, monthly, quarterly, semiannual, or annual payments on a loan, or compounding interest on a loan. Up to 36 combinations of time periods are possible. You can also value a monthly payment as an annuity, on the assumption of monthly payments and compounding of discounts, for as many months as you select.

Effortless Interest costs $25. For more information, contact MicroCost Software, 22015 Marine View Dr. S, Des Moines, WA 98198, (206) 878-2796.

Inquiry 588.



Palantir's window-oriented spelling checker.

Spell-Check Windows

Palantir Software's Windows Spell was created for use with Microsoft Windows, but it will work with most windows documents, the company reports.

Windows Spell can check spelling in long documents while you work on another application. It will flash when it spots a spelling error. The program comes with a 65,000-root-word dictionary, and it will display guesses to help you correct misspellings.

Suggested retail price of Windows Spell is $79.95. It runs on IBM PCs and compatibles with 512K bytes of RAM. For more information, contact Palantir Software, 12777 Jones Rd., Suite 100, Houston, TX 77070, (713) 955-8880.

Inquiry 589.

Printer Command Control

The memory-resident program Key Print from Instant Data Processing Inc. lets you send commands to keypress. You can set the trigger keys and printer commands although the program has predefined files that you can use or reconfigure.

IDPI claims that the program supports all printers. It is compatible with the IBM PC family and requires MS-DOS or PC-DOS 2.0 or higher. The minimum memory requirement is 128K bytes of RAM.

Key Print sells for $18. For more information, contact Instant Data Processing Inc., 411 East Commercial Way, La Habra, CA 90631, (213) 691-0216.

Inquiry 590.

WHERE DO NEW PRODUCT ITEMS COME FROM?

The new products listed in this section of BYTE are chosen from the thousands of press releases, letters, and telephone calls we receive each month from manufacturers, distributors, designers, and readers. The basic criteria for selection for publication are: (a) does a product match our readers' interests? and (b) is it new or is it simply a reintroduction of an old item? Because of the volume of submissions we must sort through every month, the items we publish are based on vendors' statements and are not individually verified. If you want your product to be considered for publication (at no charge), send full information about it, including its price and an address and telephone number where a reader can get further information, to New Products Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Business Database for IBM PCs

TeleMagic! maintains your database of contacts, telling you who to call and when, and even dials the phone. You can produce labels, letters, order forms, invoices, packing slips, envelopes, phone lists, and customer names with one keystroke. A scripting feature enables telemarketers to run through a sales presentation, making changes as necessary according to the customer's response.

The list price of TeleMagic! is $95. Contact Remote Control, P.O. Box 2861, Del Mar, CA 92014, (800) 992-9952; in California, (800) 992-5228.

Inquiry 591.

Small Business Accountant

PC Accountant enables you to keep track of your small-business income and expenses. It can print and address checks, balance your bank accounts, and track accounts payable and receivable. It can also provide reports on income and expenses. PC Accountant can handle up to 200 names and addresses, 200 accounts with balances, and 1500 transactions per month. Menus and windows guide you through the program.

You need an IBM PC or compatible with 128K bytes of RAM, MS-DOS or PC-DOS 2.1 or higher, a monochrome or color monitor, an 80-column printer, and one floppy disk drive.

The program costs $39.95 plus $5 shipping. Contact Business Applications Inc., 3211 Bonnybrook Dr. N, Lakeland, FL 33803, (813) 644-5026.

Inquiry 592.

EVENTS AND CLUBS

October 1986

EVENTS

PC EXPO, McCormick Place II, Chicago, IL. Jim Mion, PC Expo, 333 Sylvan Ave., Englewood Cliffs, NJ 07632, (800) 922-0324; in New Jersey, (201) 569-8542. *October 7–9*

ECCO's SIXTH ANNUAL EDUCATIONAL COMPUTER FAIR—THE COMPUTER CONNECTION: USING THE COMPUTER IN THE CLASSROOM, Cleveland, OH. Alice Fredman, Educational Computer Consortium of Ohio, 1123 S.O.M. Center Rd., Cleveland, OH 44124, (216) 461-0800. *October 9–10*

SIXTH ANNUAL SYMPOSIUM ON SMALL COMPUTERS IN THE ARTS, Philadelphia, PA. Symposium, P.O. Box 1954, Philadelphia, PA 19107. *October 10–12*

FIFTH INTERNATIONAL ELECTRONIC IMAGING CONFERENCE & EXHIBITION, Arlington, VA. Conference Management Corp., 17 Washington St., P.O. Box 4990, Norwalk, CT 06856-4990, (203) 852-0500. *October 14–15*

SECOND ANNUAL CONFERENCE: COMPUTER TECHNOLOGY/SPECIAL EDUCATION/REHABILITATION, California State University, Northridge. Dr. Harry Murphy, CSUN Office of Disabled Student Services, 18111 Nordhoff St., Northridge, CA 91330, (818) 885-2578. *October 16–18*

UNIX EXPO, Jacob K. Javits Convention Center, New York, NY. National Expositions Co. Inc., 49 West 38th St., Suite 12A, New York, NY 10018, (212) 391-9111. *October 20–22*

INFOMATICS 86, Sheraton Centre, Toronto, Ontario, Canada. Infomatics 86, International Information Management Congress, P.O. Box 34404, Bethesda, MD 20817, (301) 983-0604. *October 20–23*

SECOND ANNUAL SYMPOSIUM FOR MICROCOMPUTERS IN LAW ENFORCEMENT, Jacksonville, FL. Russ Arend, Institute of Police Technology and Management, 4567 St. Johns Bluff Rd. S, Jacksonville, FL 32216, (904) 646-2722. *October 21–23*

ERGODESIGN '86: THE EVOLUTION OF THE ELECTRONIC WORKPLACE, Montreux, Switzerland. Ergodesign '86, P.O. Box 122, CH-1820 Montreux, Switzerland, telephone: (21) 63 04 40, telex: 453 254 mtx ch. *October 21–24*

THIRD ANNUAL FLAT INFORMATION DISPLAYS CONFERENCE, San Jose, CA. International Planning Information Inc., 465 Convention Way, Suite 1, Redwood City, CA 94063, (415) 364-9040. *October 22–23*

INTERNATIONAL COMPUTERS & COMMUNICATIONS 1986–2000, Washington, DC. International Computers & Communications, P.O. Box 17392, Washington, DC 20041, (703) 476-2604. *October 22–25*

FOURTH ANNUAL COMPUTER TECHNOLOGY FOR THE HANDICAPPED INTERNATIONAL CONFERENCE, Minneapolis, MN. Closing the Gap, P.O. Box 68, Henderson, MN 56044, (612) 248-3294. *October 22–26*

MEDINFO 86: FIFTH WORLD CONGRESS ON MEDICAL INFORMATICS, Washington, DC. Medinfo 86, Secretariat: Office of CME, George Washington University, 2300 K St. NW, Washington, DC 20037, (202) 676-8929. *October 26–30*

FIFTH ANNUAL PACIFIC NORTHWEST COMPUTER GRAPHICS CONFERENCE, Eugene, OR. Pacific Northwest Computer Graphics Conference, University of Oregon Continuation Center, 1553 Moss St., Eugene, OR 97403, (800) 228-6891; in Oregon, (800) 824-2714 or (503) 686-3537. *October 27–28*

NINTH NORTHEAST COMPUTER FAIRE, Boston, MA. The Interface Group Inc., 300 First Ave., Needham, MA 02194, (617) 449-6600. *October 30–November 1.*

1986 NATIONAL CONFERENCE—EAST: COMPUTERS & READING/LEARNING DIFFICULTIES, Philadelphia, PA. Diane Frost, Educational Computer Conferences, Dept. N, 1070 Crows Nest Way, Richmond, CA 94803, (415) 222-1249. *October 30–November 1*

1986 INTERNATIONAL WORKSHOP ON FORTH AND ITS APPLICATIONS, National Taiwan Institute of Technology, Taipei, Republic of China. FORTH Interest Group, P.O. Box 8231, San Jose, CA 95155, (408) 277-0668. *October 31–November 2*

If you send notice of your organization's public activities at least four months in advance, we will publish them as space permits. Please send them to BYTE (Events and Clubs), One Phoenix Mill Lane, Peterborough, NH 03458.

CLUBS

NASHVILLE MACINTOSH USERS GROUP, c/o Clark Thomas, 2305 Ellison Place #C-5, Nashville, TN 37203, (615) 327-1757.

PC-SIG NEWS, 1030 East Duane Ave., Suite D, Sunnyvale, CA 94086, (418) 730-9291.

WORLD WIDE ST USERS GROUP, WW STUG, 77 Kenton Place, Hamburg, NY 14075.

SATRONICS INFORMATION EXCHANGE (satellite TV SIG), Mark Miller, P.O. Box 52261, Philadelphia, PA 19115. BBS at (215) 698-1905.

HOT FLASH (newsletter for UNIX users), Unisource Software Corp., Donna Woznicki, 23 East Street, Cambridge, MA 02141, (617) 577-8383.

SOUTHWEST APL USERS GROUP (SWAPL), Jim Fiegenschue, 120 Oak Grove Circle, Double Oak, TX 75067-8461, (214) 539-9281.

TINKER ATARI COMPUTER ENTHUSIASTS (TACE), P.O. Box 19456, Oklahoma City, OK 73144.

CALGARY HYPERION USER'S GROUP (CHUG), David Tansey, 3411—33 Street SE, Calgary, Alberta, Canada T2B 0V9.

GREEN COUNTRY COMPUTER ASSOCIATION, Michael S. Keller, P.O. Box 497, Tulsa, OK 74101.

MS-DOS USER GROUP (MUG) OF OLYMPIA, Brian Geppert, 1321 Skyridge Street SE, Lacey, WA 98503.

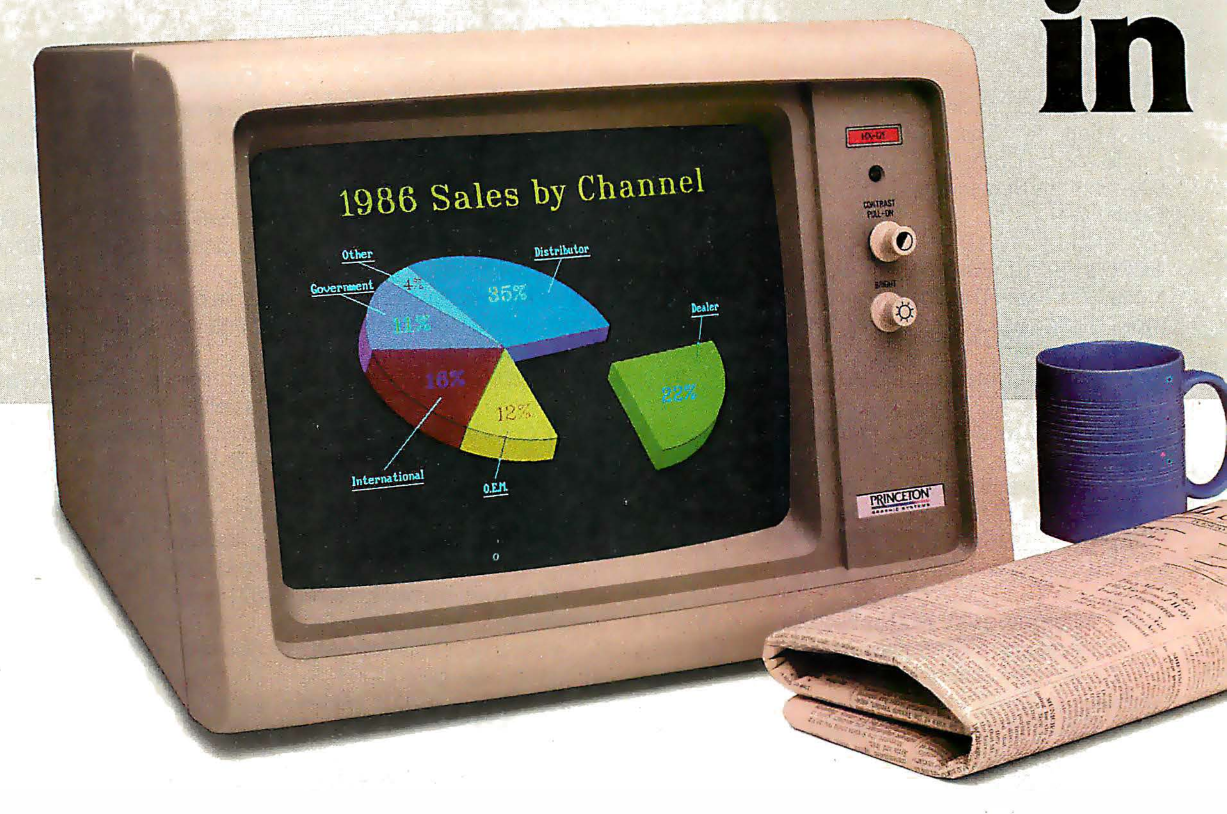
THE CARRIER (journal of the Telecommunications Users Group), P.O. Box 45254, Seattle, WA 98145-0254.

CODEWORKS (magazine devoted to problem solving with BASIC), 80-Northwest Publishing Inc., 3838 South Warner, Tacoma, WA 98409-4698, (206) 475-2219.

LASERBOARD, NEW YORK'S ELECTRONIC MAC USER'S GROUP, Stuart Gitlow, 1212 Fifth Avenue, Suite 15C, New York, NY 10029-5210, (212) 831-6413 (voice), 348-5714 (data).

THE SENTINEL (newsletter for TI Professional users), Dick Mitch, Box 635, Dunlap, CA 93621, (209) 338-2472. ■

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Full EGA and CGA support. Princeton EGA monitors bring you 64 brilliant colors and bright sharp images in enhanced graphics mode, with 640 x 350 resolution. Your EGA software never looked better. Plus our HX-12E and HX-9E automatically switch from EGA to CGA mode, when needed.

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Reliability. Princeton monitors are designed and manufactured to meet your most demanding needs. Only the finest components are used. The result: dependable performance day in and day out.

Value. No other monitor gives you more for the money than Princeton. Compare for yourself. Feature for feature there's not a better value around.

Availability. Princeton monitors are as easy to get your hands on as they are easy to use. You can find them at computer stores around the world.

Reputation. More and more, people are making Princeton Graphic Systems their number one choice in personal computer displays. Because people know Princeton delivers the ultimate in compatibility, reliability, and performance.

best choice EGA monitors.



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HX-9E. The first IBM compatible 9" high resolution color monitor to support EGA. Has a .28mm dot pitch black matrix tube and etched nonglare screen for sharp, crisp displays and features a built-in tilt/swivel stand and green/amber switch.

HX-12E. The first IBM compatible high resolution color monitor to support EGA with a .28mm dot pitch. The HX-12E builds on the award winning features of the HX-12 and features 640 x 350 resolution for sharp, crisp text and colorful graphics.

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Inquiry 239

A·S·K B·Y·T·E

Conducted by Steve Ciarcia

Foreign-Language Daisy Wheels

Dear Steve,

A letter by Chris Leiss in the November 1985 BYTE (page 48) attracted my attention. He is using a Brother CE-50 typewriter to print Arabic; I'm using a Brother HR-15 XL printer (which uses the same daisy wheels) and a BASIC program to print in various European languages (generally, European versions of American word processors do not permit you to mix several languages in the same text).

I would like to know who sells Russian and/or Greek daisy wheels that fit the Brother printers.

J. Dings
Pisa, Italy

You're in luck! I found a distributor that can obtain Russian and Greek print wheels for your printer.

Mr. Peter Neidenbach
PrinterLand Inc.
210 West Roosevelt Rd.
Villa Park, IL 60181
(314) 833-5074

Mr. Neidenbach stated that he could obtain other foreign-language print wheels as well.—Steve

C Compilers

Dear Steve,

At present, I am doing some initial work using a BASIC compiler. I am not satisfied, however, because the resulting programs are far slower than I expected (besides, the version I have does not support the 80287). I would like to use a C compiler instead, and I need one that meets the following requirements:

- Optimized for the 80286/80287 instruction set
- Supports virtual memory
- Graphics support for the IBM Professional Graphics Adapter (PGA)
- Can address more than the 640K-byte memory limit imposed by PC-DOS
- Has a friendly and effective editor and debugger

Also, I recently acquired an OEM board of an IBM PC AT–compatible computer. This machine is equipped with an 8-MHz 80286 and 80287. I intend to use this machine for real-time 3D graphics animation. Could you help me find references for further study? I am also very interested in fractal geometry.

Do you have any suggestions?

Anthony Cayetano
Paranaque, Philippines

The January 1986 issue of PC Tech Journal *reviewed a crop of C compilers. Rather than pick one out of the list for you, I'd suggest that you go through the article and match them against your requirements. However, some caveats are in order.*

None of the compilers will generate code for the 80286 in protected mode because DOS doesn't support this. Therefore, all of your programs will treat the 80286 as just a faster 8086. Similarly, the 80287 will be run as a faster 8087.

The 640K-byte limit imposed by DOS is, unfortunately, rooted in hardware: That's all the space that's left after you account for all the display adapters and whatnot that share the address space with the system RAM. The 80286 can address up to 16 megabytes in protected mode, but you can't get there from here. The new Lotus/Intel/Microsoft Expanded Memory Specification boards allow you to stuff up to 8 megabytes in a PC, but it's bank-switched using four 16K-byte windows inside the 640K-byte limit and isn't handy for your project.

Similarly, virtual memory is handled by the operating system rather than the language. PC-DOS, as you might have guessed by now, doesn't support virtual memory.

Support for the PGA isn't part of the compiler but is provided as either a set of library functions or a device driver. Given the complexity of the PGA, the support code is only now starting to appear, and I don't have any recommendations on any packages.

The basic reference for fractals is The Fractal Geometry of Nature *by Benoit B. Mandelbrot (W. H. Freeman, 1982). It's not particularly helpful with programming, but it gives you a good understanding of just what fractals are. The Computer Recreations column of* Scientific American *has had several fractal and 3D programs lately.*—Steve

New Life for Lil' Orphan Adam?

Dear Steve,

I am planning to buy a Coleco Adam. It's cheap, comes with a word processor in ROM and a printer, and has a keyboard that feels comfortable to me. However, I like to program in C, and since the machine does not come with CP/M or a disk drive, I must find a way to port a C compiler over to the Adam.

I have decided that the easiest way to do this is to write a macro assembler in Coleco's SmartBasic, use the assembler to write a TIL (threaded interpreted language)-based operating system, and then write a C compiler in TIL code. The compiler that I have settled on is the Small-C compiler. I have the source code for this compiler in *The Small C Handbook* by Hendrix (Reston, 1984). Unfortunately, the compiler uses a standard function library as well as an "stdio.h" file, and the source code for either file is not listed in the book. Where can I get an example of the source code for a Z80-based system?

Also, I was recently reading a copy of *Computer Shopper* magazine, in which I ran across an advertisement for a subscription to a magazine called *Computersmyth*. I cut out the return slip and purchased a money order for a two-year subscription, but

(continued)

IN ASK BYTE, *Steve Ciarcia answers questions on any area of microcomputing. The most representative questions received each month will be answered and published. Do you have a nagging problem? Send your inquiry to*

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Due to the high volume of inquiries, personal replies cannot be given. All letters and photographs become the property of Steve Ciarcia and cannot be returned. Be sure to include "Ask BYTE" in the address.

The Ask BYTE staff includes manager Harv Weiner and researchers Eric Albert, Bill Curlew, Ken Davidson, Jeannette Dojan, Jon Elson, Roger James, Frank Kuechmann, Dave Lundberg, Edward Nisley, Dick Sawyer, Andy Siska, and Robert Stek.

MICROSOFT LANGUAGES NEWSLETTER Vol. 1, No. 10

News about the Microsoft Language Family

Compiling With The *cl* Interface in Microsoft® C Compiler

The *cl* interface is an alternative driver to *msc* that comes with the Microsoft C Compiler. It is very similar to the XENIX® and UNIX™ *cc* driver. *cl* will not only compile your program, but will also compile and link multiple source files, object files and libraries, all in one step. *cl* looks at the file name extension (.c or .obj) and determines whether it is necessary to compile and link or just to link.

Example:

cl -Ox -FPa -F 2000 -Zi main.c subl.obj -link mylib.lib

This example compiles main.c, creating main.obj, then links main.obj file with subl.obj, the alternative math library (/FPa) and mylib.lib. /Ox sets maximum optimization, with stack checking off. The executable stack size is set to 8K (decimal) with /F 2000(hex). Full symbolic information for use with Microsoft CodeView™ is enabled.

As with *msc*, *cl* will automatically use the PATH, INCLUDE, TMP and LIB environment variables. This allows you to set up specific search paths for your executable compiler files, include files, temporary files and library files.

All of the options available with *msc* are also available with *cl*. The default options for the Microsoft C Compiler Version 4.0 interfaces are as follows:

—As	Small Model.
—FPi	Generous floating point calls; selects emulator math library.
—Ot	Controls optimizations; favors execution time.
—Ze	Enables language extensions, such a *cdecl, far, fortran, huge, near, pascal.*

The default for the —Ox option has been changed to favor execution time.

In addition, *cl* will automatically invoke the linker and use the default C libraries. The following are some of the options that are available from *cl*:

—link "libraryfield"	The linker is invoked; linker options and alternate library names may be given.
—c	Suppress linking.
—Fe	Names the executable file.
—Fm	Creates a map file.

Third-Party Libraries Available For Microsoft FORTRAN Compiler

Microsoft FORTRAN for MS-DOS® provides a number of utilities and math libraries in the product itself, but there are a number of additional subroutine libraries that can be obtained through third-party software vendors that could speed your development even more. There are a whole range of graphic libraries such as plotting libraries (ATC, Microcompatibles, GSS), 3-D graphics (Microcompatibles), ANSI/ISO graphics (GSS, ATC), image processing (Werner Frei) and general graphics (Media Cybernetics). If you need data management, Softcraft provides Btrieve for ISAM support and Microrim provides a Microsoft FORTRAN program interface to their RBase product. Although Microsoft FORTRAN math support is already extensive, there are other more specialized math libraries available such as modelling (Mitchell & Gauthier), FFT (MicroWay, Wiley), vector, matrix numerical analysis, signal and image processing libraries (Wiley, Quantitative Technology Corporation, Systolic Systems), statistic (Wiley, IMSL, MAGUS, IMSL), and broad engineering/scientific math libraries (Wiley, NAG). General purpose libraries are available through MEF that provide communications, file management, graphics, DOS, screen handling and string handling support all in one package. Even very specialized libraries such as IEEE 488 Support (Tecmar) are available.

Contact these third party vendors for more information on their libraries for Microsoft FORTRAN or receive a copy of the Language Support Directory by contacting Microsoft.

For more information on the products and features discussed in the Newsletter,
write to: Microsoft Languages Newsletter
16011 NE 36th Way, Box 97017, Redmond, WA 98073-9717
Or phone:
(800) 426-9400. In Washington State and Alaska, call (206) 882-8088. In Canada, call (416) 673-7638.

Latest DOS Versions:

Microsoft C Compiler	4.00
Microsoft COBOL	2.10
Microsoft FORTRAN	3.31
Microsoft Macro Assembler	4.00
Microsoft Pascal	3.31
Microsoft QuickBASIC	2.00

Look for the Microsoft Languages Newsletter every month in this publication.

before I could mail it out, I lost the slip of paper with the address on it. Can you help?

DEREK A. BENNER
Missoula, MT

Woof! You've certainly got a project in front of you!

The original source for Small-C was Dr. Dobb's Journal *in 1980. Version 2 of the language was presented in that magazine in December 1982 and January 1983, with source for a small library. An expanded library was printed in May and June of 1984, and a variety of additions, corrections, and modifications have come out since then. Most of the library functions are in C rather than assembler, so you may well be in luck. Also, you may want to look at* Dr. Dobb's Toolbook of C, *a recently published book available from M & T Publishing Inc. ((415) 366-3600, ext. 216).*

In all seriousness, I think that your project is too big for an Adam. Given the amount of software you're planning to write and the amount of debugging required to get it all running, you're going to spend an unreasonable amount of time watching those little tape drives whir. You can get a single-board CP/M system for about the same money, so an orphan Adam doesn't make sense.

Computersmyth *caters to hardware tinkerers of all flavors and has had a variety of interesting articles in the first four issues. The address is*

Computersmyth
P.O. Box 176
Peterborough, NH 03458

—Steve

COMPUTERIZING MODEL RAILROADS

Dear Steve,

One of my hobbies is model railroading. For many years I have wondered about the practicality of using a computer to completely control a model railroad (including switching operations), which I could scale up to a railroad of arbitrary size. I think that I have solved all the engineering problems except one, and perhaps you can help me with it.

The problem is train sensing. Most train sensors I know of merely detect whether railroad cars are in track blocks. I need more precision. I recently had an idea to use strain gauge sensors in the track, possibly across rail gaps, to sense when train wheels pass points on the railroad.

Using wheel counting and a real-time clock (and software that I believe I can write), I could get very precise measurements of train position and speed. I could even sense derailments and broken trains.

I know very little about strain gauges. How sensitive are they? I need to sense the presence of ⅜ ounce (3-ounce model railroad car divided by 8 wheels). Thanks for any information you can give me.

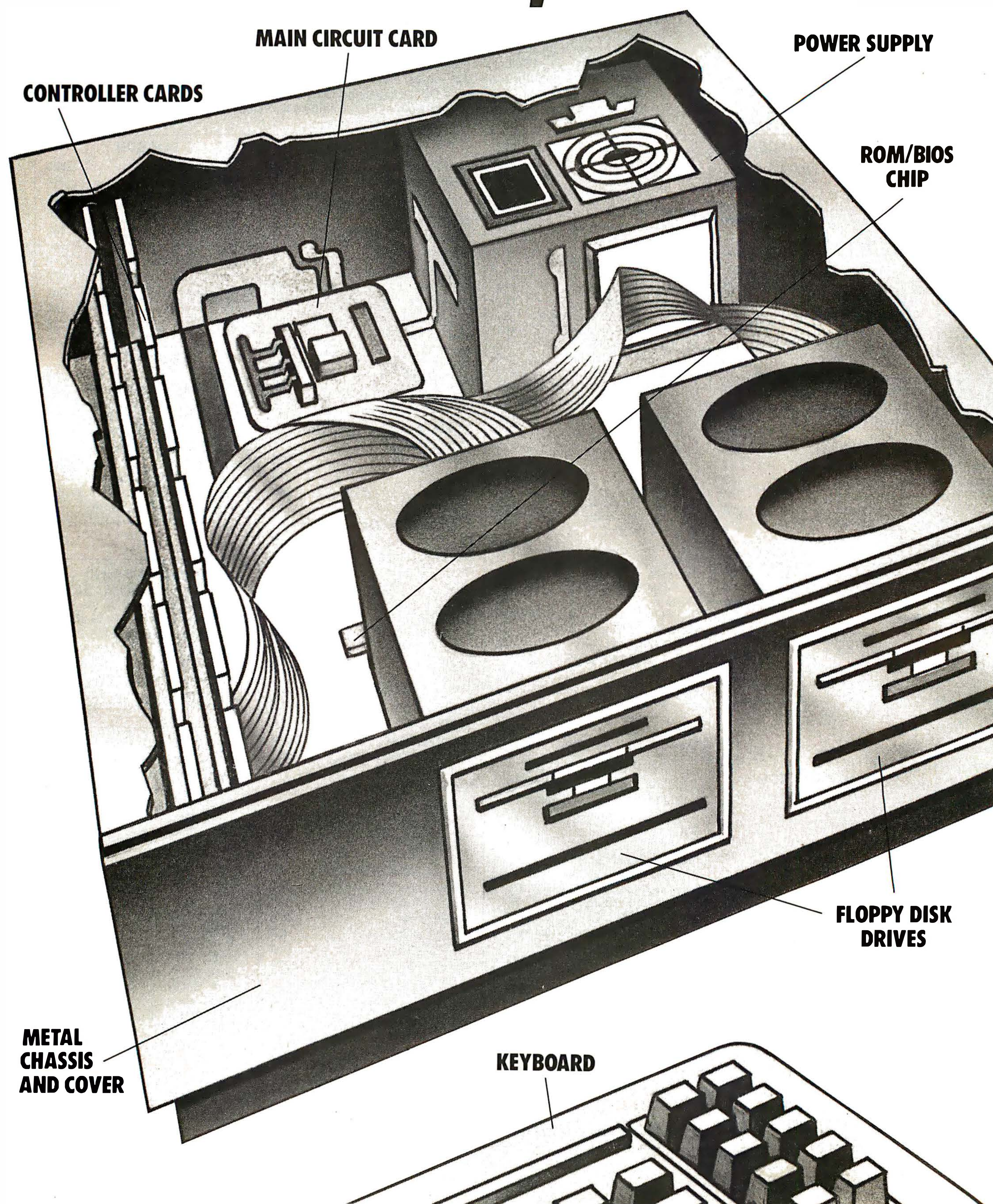
DAVID W. ROSCOE
Chelmsford, MA

Strain gauges are very tricky components, and you can make them as sensitive as you need. They are used in microgram analytical balances, which are more sensitive than any beam balance. They provide millivolt signals, however, and require complicated amplifiers and very effective noise shielding to work properly.

I would recommend that you try another approach to train sensing. An op-

(continued)

ANYONE CAN BUILD A CLONE, BUT...



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Everyone seems to be jumping on the bandwagon.

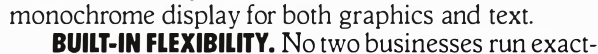
Today, companies that weren't there yesterday, and may not be there tomorrow, are building computers from easily assembled components.

The result is a sea of computer clones with little to distinguish one from another.

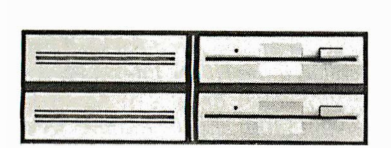
THE PANASONIC DIFFERENCE—A POWERFUL BUSINESS ALLY. Our approach to offering you a computer was entirely different. We looked at what would work best for you and your business.

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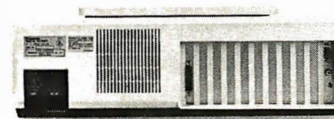
BUILT-IN FLEXIBILITY. No two businesses run exactly the same way. So you can configure the Business Partners to your own individual needs. In addition to their built-in floppy disk drives, you can add a hard disk drive, additional half-height drives—even a magnetic tape drive.



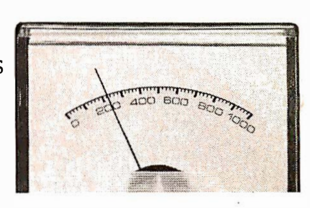
SPEED AND PERFORMANCE. The Business Partner 286 is built with maximum power and speed. Its 80286 processor runs at 6 MHz or 8 MHz, with the ability of addressing up to 15Mb RAM.

The Business Partner, with its 8086-2 processor, runs at 4.77 MHz, and for projects that need added acceleration, it will run up to 7.16 MHz.

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POWER TO SPARE. As your business grows, you'll put greater demands on your Business Partner. Don't worry, it can handle it. With 130 watts on the Business Partner and 220 watts on the Business Partner 286, you'll be able to drive additional peripherals and expansion boards.

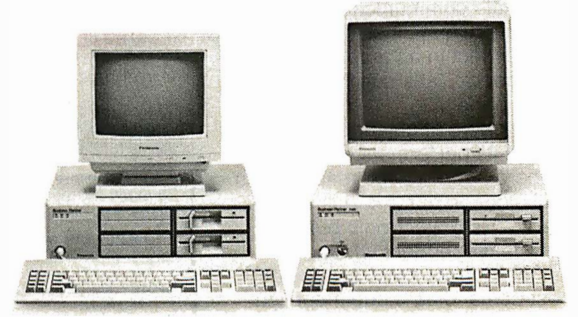


IMPORTANT DESIGN CONSIDERATIONS. The deluxe, detachable keyboards on both models have been designed for comfort and ease of use. We've separated the cursor keys and numeric keys for quick, convenient access. Swivel monitors adjust for each operator. On the Business Partner 286, you can lock the cabinet with a key to help prevent tampering and prying.



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And more importantly, both Business Partners are from Panasonic, the company firmly committed to building a high-quality and dependable reputation in computer products. So both are backed with a full-year limited warranty.



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*IBM is a registered trademark of the International Business Machines Corp.

Inquiry 224

tical sensor placed under the track would work very well. If you want to sense wheels, you could put sensors on opposite sides of the track, just peeking over the top of the rails. You could put these in housings that would look very much like standard railway equipment, so as not to be unrealistic. A sensor under the track could sense available room light, while the wheel sensors could use paired infrared emitters and detectors.

A third approach would be to use the reflective sensing emitter-detector sets and put a bit of aluminized plastic tape on the bottom of each car that could be sensed from below the track. To get really fancy, put a bar code on each car and have the computer keep track of individual cars and locomotives.

If the sensors are infrared phototransistors, the interface to TTL levels can be a transistor or a comparator. The comparator gives more sensitivity and a way to set each sensor for the optimum threshold to compensate for mechanical, optical, and component variations (which are rather large in LEDs and photodetectors).—Steve

USING AN IEEE-488 PORT

Dear Steve,

I have a Zorba CP/M computer that has, among numerous other features, an IEEE-488 port installed. I am interested in using this port to drive peripherals such as speech synthesizers, voice recognition units, and nonwire communication links (light beam, radio, etc.) to robots and other computers. There seems to be a dearth of information on this port in the popular literature.

Have you had any experience using the IEEE-488 port? Can you refer me to any sources of information on it? From what I have seen, it has been wrongfully neglected.

BILLY R. ROGUE
Lake Havasu City, AZ

The IEEE-488 bus is an 8-bit parallel bus that was originally designed to connect test and measurement instruments to early programmable calculators to form production test systems in factories. The document, IEEE Standard 488–1978, Digital Interface for Programmable Instrumentation, *can be obtained from the IEEE. Another source is the Intel Component Data Catalog. The section on the 8291, 8292, and 8293 circuits has much information on this bus and describes interface circuits as well. Intel calls the IEEE-488 the GPIB (general-purpose interface bus) and Hewlett-Packard originally called it the HP-IB. Intel in Phoenix ((602) 997-9695) or BFA in Scottsdale ((602) 924-5400) should be able to get you the Intel catalog.*—Steve

CIRCUIT CELLAR FEEDBACK

LED GRAPHICS DISPLAY PANEL

Dear Steve,

I am interested in building a light panel with incandescent or LED lamps (colored, if possible) that I can use as an advertisement board. I would like to construct a panel ranging in size from 3 feet by 4 feet to possibly 12 feet by 12 feet, capable of displaying text, graphics, or animation.

I presently have an Apple IIe, an 80-column card, Duodisk, Imagewriter, and a green monochrome monitor. I have seen

(continued)

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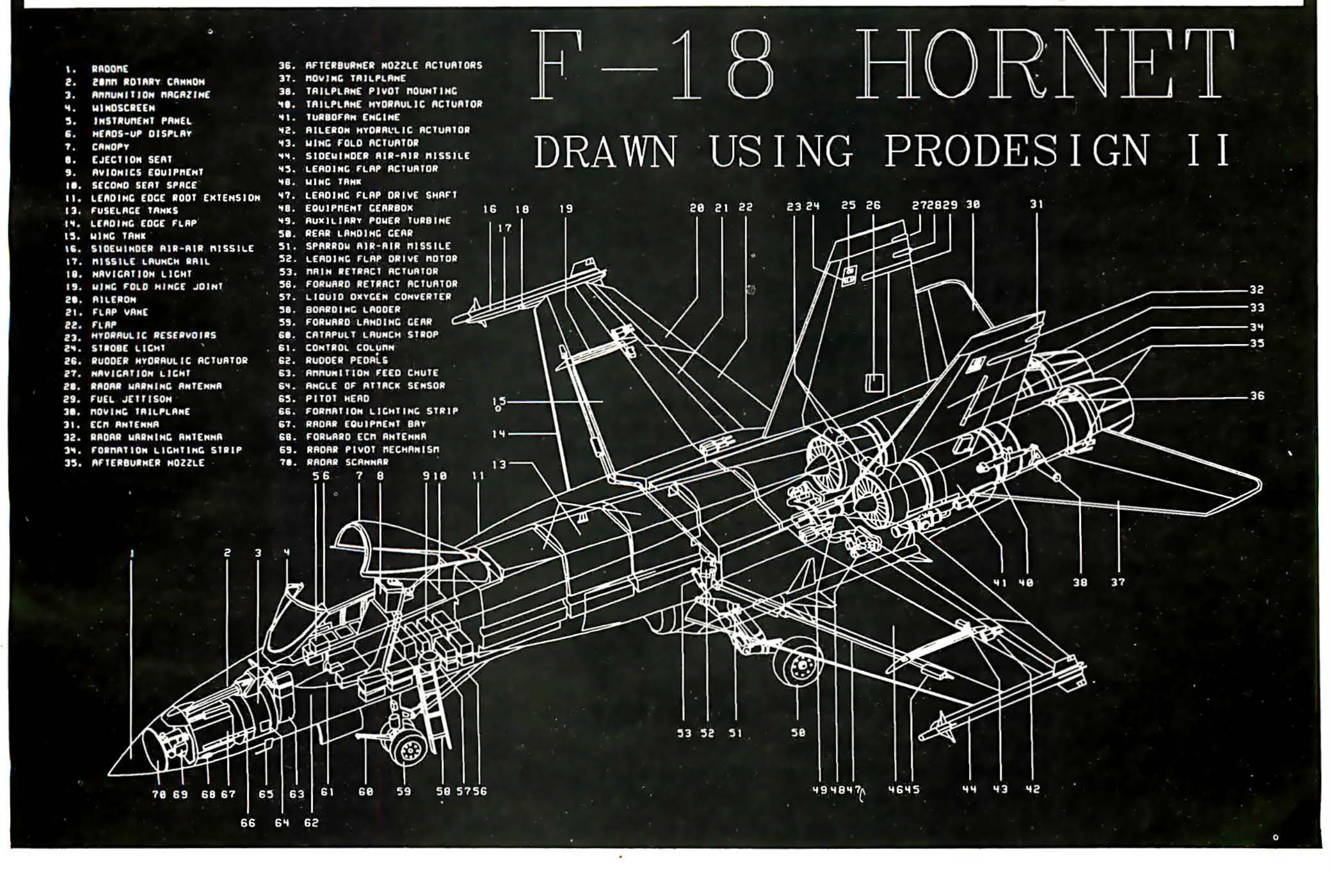
What additional hardware do you need? None! An IBM PC compatible and 512K RAM are all you need. ProDesign II produces high resolution drawings on your dot matrix printer - better than .005" resolution on an IBM/Epson compatible printer. And you don't have to get a mouse or digitizing tablet. ProDesign II is designed for easy and efficient keyboard use. You won't even need a math coprocessor, although it is supported. From a small drawing on a dot matrix printer to an E-Size drawing on a large plotter, ProDesign II is the one to use!

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American Small Business Computers, Inc.
118 South Mill Street
Pryor, OK 74361
918/825-4844

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software from Broderbund called Fantavision that does color animation on the IIe and is reportedly able to do up to a three-hour show.

I know a little about electricity and would like to build a small panel to experiment with. Can you give me any information on this?

KENT BARNARD
Wayne City, IL

Volume II of Ciarcia's Circuit Cellar *(BYTE Books, McGraw-Hill) contains details on a self-refreshing LED graphics display panel. The circuits shown in that article could be readily adapted to the Apple IIe (you could drive them using a parallel port). This would allow you to experiment with the fundamentals.*

The April 1984 Circuit Cellar column featured a scrolling LED display driven by the Z8 control computer. This display could also be driven by a suitably equipped Apple.—Steve

TESTING AND RECALIBRATING FLOPPY DISK DRIVES

Dear Steve,

I am in charge of the PC Laboratory at the Weizmann Institute. We have over 100 IBM and IBM-compatible PCs and two of us to give advice on purchasing hardware and software, hooking it all up, arranging for maintenance, etc. I wonder if you could help us with one of our biggest maintenance headaches—floppy disk drives.

As a research institution, we are exempt from custom duties on most laboratory equipment that we buy. Therefore, we often buy mail-order equipment from the United States (often from advertisements in the back of BYTE), since it can be cheaper than ordering from a dealer here. This has had mixed results in terms of the quality of the hardware we purchase. For instance, we have ordered drives that, when we receive them, don't work until we play around with the little jumpers on the drive circuit board (e.g., DS0, DS1, MS, HS, etc.). Of course, the drives never come with documentation, so I am working in the dark. I have been forced to pay an outside laboratory to adjust some drives that I couldn't get to work.

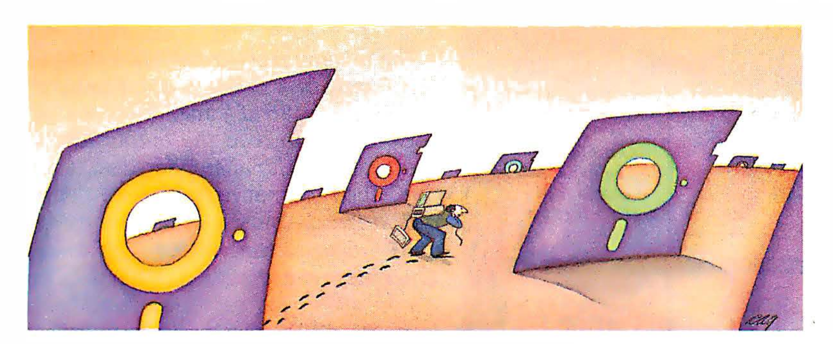
I also find that heavily used floppy disk drives go out of calibration. There is a laboratory here that repairs drives, but it seems a shame to pay them $75 to calibrate a drive that costs $100 new. While we do not intend to become a facility for repairing drives, I would like to be able to recalibrate them here.

Could you recommend a book on floppy disk drive maintenance? Also, perhaps

(continued)

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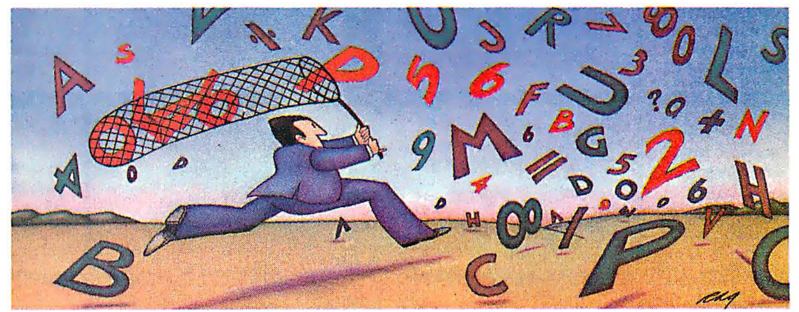


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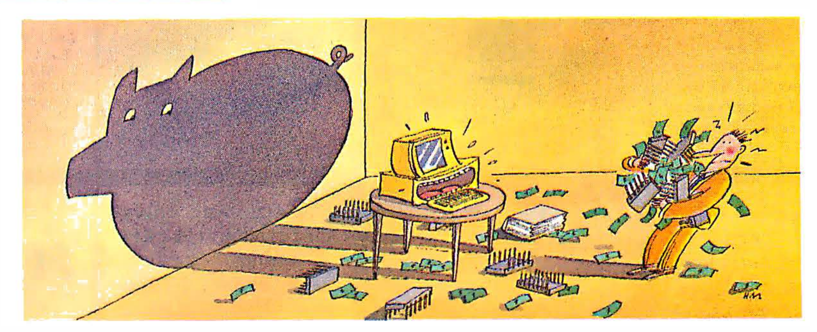


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you could suggest what sort of equipment we would need to keep drives calibrated?

Samuel Gamoran
The Weizmann Institute of Science
Israel

The minimum equipment you need to test floppy disk drives is a computer to run the drive, an alignment disk, and an oscilloscope to read the output signals produced by the alignment disk.

PC Tech Journal *reviewed five floppy disk drive diagnostic disks in the May 1985 article "Testing 1,2,3,4,5" by James Chumbley. These disks provide data on speed, alignment, centering, head backlash, etc. Of the five, only the following vendors provided quantitative data:*

Interrogator
Dysan Corporation
1244 Reamwood Ave.
Sunnyvale, CA 94089
(408) 734-1624

Memory Minder
J & M Systems Ltd.
15100A Central Ave. SE
Albuquerque, NM 87123
(505) 292-4182

ReadiScope
ReadiWare Systems Inc.
P.O. Box 515
Portage, MI 49081
(616) 327-9172

Recent issues of Computer Shopper *magazine carry ads for disk drive service manuals from*

Consumertronics Co.
Attn.: Computers
2011 Crescent
Alamogordo, NM 88310

and a drive tester, the EX2000 Disk Drive Exerciser, from

Proto PC
2439 Franklin Ave.
St. Paul, MN 55114
(612) 644-4660

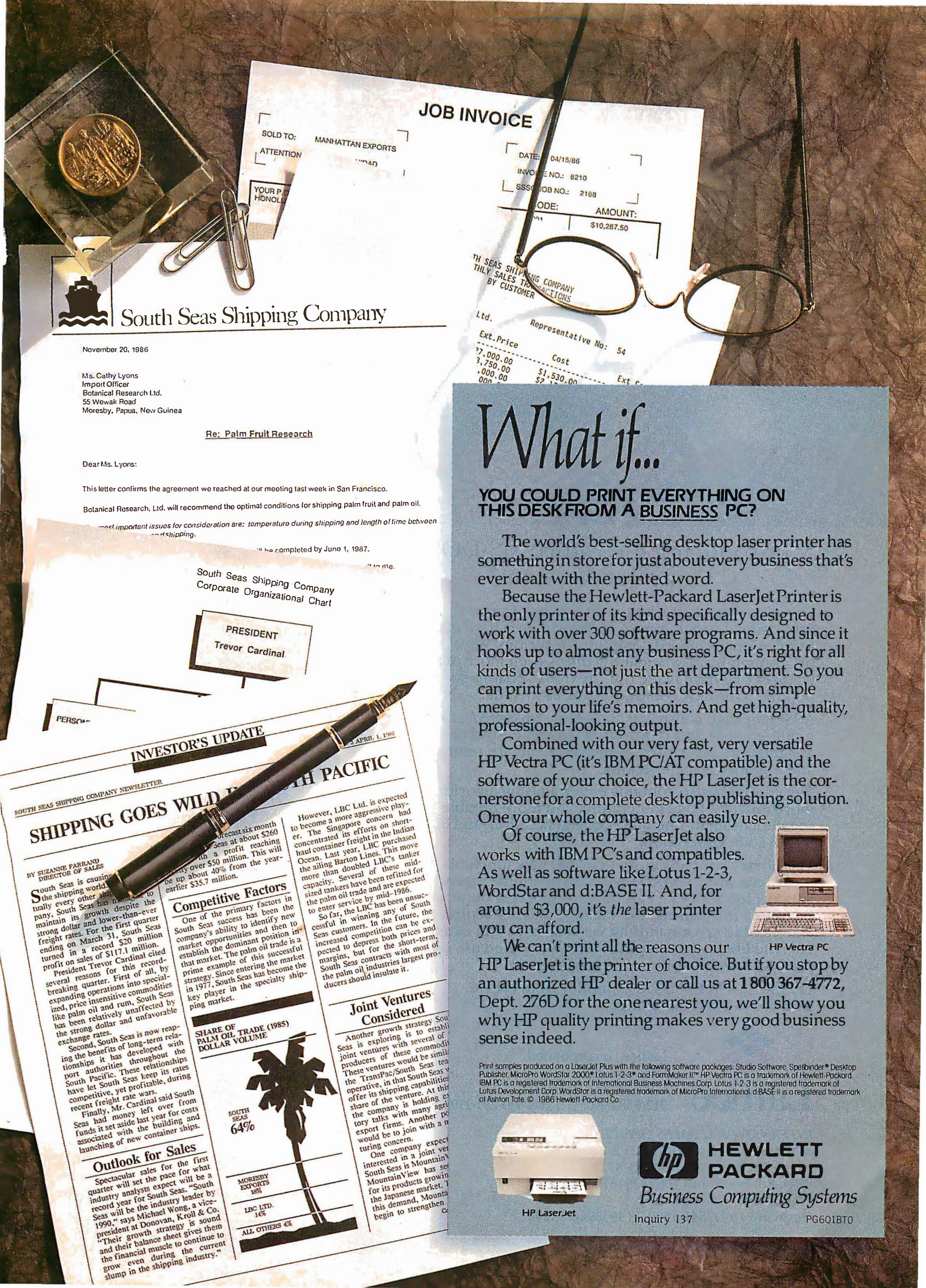
—Steve

Music Project for the IBM PC

Dear Steve,

I am interested in using an IBM PC–type computer for music synthesis and audio editing. Ideally, such a system would be capable of digitizing input data on a single channel with 12-bit resolution and 50-kHz sampling rate. It should also be capable of synthesizing two channels with a 12- to 16-bit dynamic range at the above sampling rate. A 40-megabyte hard disk could store six minutes of input data and three

(continued)


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November 20, 1986
Ms. Cathy Lyons
Import Officer
Botanical Research Ltd.
55 Wewak Road
Moresby, Papua, New Guinea
Re: Palm Fruit Research
Dear Ms. Lyons:
This letter confirms the agreement we reached at our meeting last week in San Francisco.
Botanical Research, Ltd. will recommend the optimal conditions for shipping palm fruit and palm oil.
South Seas Shipping Company
Corporate Organizational Chart
PRESIDENT
Trevor Cardinal
INVESTOR'S UPDATE
SHIPPING GOES WILD
Competitive Factors
Outlook for Sales
Joint Ventures Considered
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Combined with our very fast, very versatile HP Vectra PC (it's IBM PC/AT compatible) and the software of your choice, the HP LaserJet is the cornerstone for a complete desktop publishing solution. One your whole company can easily use.
Of course, the HP LaserJet also works with IBM PC's and compatibles. As well as software like Lotus 1-2-3, WordStar and d:BASE II. And, for around $3,000, it's the laser printer you can afford.
HP Vectra PC
We can't print all the reasons our HP LaserJet is the printer of choice. But if you stop by an authorized HP dealer or call us at 1 800 367-4772, Dept. 276D for the one nearest you, we'll show you why HP quality printing makes very good business sense indeed.
Print samples produced on a LaserJet Plus with the following software packages: Studio Software, Spellbinder® Desktop Publisher, MicroPro WordStar 2000,® Lotus 1-2-3® and FormMaker II.™ HP Vectra PC is a trademark of Hewlett-Packard. IBM PC is a registered trademark of International Business Machines Corp. Lotus 1-2-3 is a registered trademark of Lotus Development Corp. WordStar is a registered trademark of MicroPro International. d:BASE II is a registered trademark of Ashton Tate. © 1986 Hewlett-Packard Co.
HP LaserJet
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Business Computing Systems
Inquiry 137
PG601BT0

minutes of stereo output. Obviously, the data transfer rates would be quite high (200K bytes per second), requiring specialized hardware such as a dual-port memory buffer. Are you aware of any commercially available option boards for the PC that might perform these functions? If not, do you have any interest in developing such a board?

DAVID J. STATES
San Diego, CA

I don't have a music project like you requested in the works at this time for the IBM PC. There are a few A/D boards capable of sampling at rates of 50 kHz or more; a couple of vendors are

Metrabyte
440 Myles Standish Blvd.
Taunton, MA 02780
(617) 880-3300

Data Translation Inc.
100 Locke Dr.
Marlborough, MA 01752
(617) 481-3700

If you can reduce the 50-kHz sample rate, you might get by with an IBM PC with a hard disk. I calculate a data rate of 100K bytes per second, assuming the 12-bit data is stored as 16-bit words to save time (I don't have a calculation for the compression time). This is a little fast for a PC. The Norton Utilities Disk Test can read an entire 10-megabyte hard disk with an interleave factor of 2 in just about 2 minutes, or 83K bytes per second. This isn't up to the specified data rate of 5 megabits per second for this drive/controller, but it is consistent with wait states for the PC DMA controller and a little processing by the controller, and, thus, is probably close to what you can expect in real applications.

A PC AT or one of the faster clones might be better. If you want real speed, you might consider an array processor of the type available from Data Translation or Datacube as well as other companies. These are usually used as high-speed graphics processors but are quite adaptable.—Steve ■

Over the years I have presented many different projects in BYTE. I know many of you have built them and are making use of them in many ways.

I am interested in hearing from any of you telling me what you've done with these projects or how you may have been influenced by the basic ideas. Write me at Circuit Cellar Feedback, P.O. Box 582, Glastonbury, CT 06033, and fill me in on your applications. All letters and photographs become the property of Steve Ciarcia and cannot be returned.

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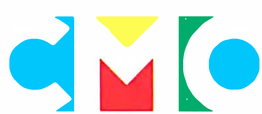
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It turned out the customer had worked as a sales rep for a competitor of ours. He said it takes them 3 or 4 weeks to complete most orders. Consequently, he didn't think there was any hurry to get a check ready for the CMO order.

"They must have a lot of cancelled orders," I said.

He said yes, that in a typical month they only ship 40% of what's ordered.

That surprised me. I told him we ship 90% of our orders the next day. And we have very few cancellations.

Well, everything worked out. I apologized for our promptness. He laughed and said he'd be ready for us the next time he ordered.

And we'll be ready for him.

CMO is committed to its customers. We operate an IBM System 38 with state-of-the-art software to help expedite the tens of thousands of orders we receive. Thanks to this system CMO is able to provide customers with up-to-the-minute information about their orders.

Thomas A. Penfield

Thomas A. Penfield
Sales Manager, CMO

SOFTWARE.

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d-Base III+ ... 429.00
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Borland
Reflex ... 59.99
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Central Point Software
Copy II PC ... 24.99
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Fastback ... see special
IMSI
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Lifetree
Volkswriter III ... 149.00
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MicroPro
Wordstar 2000+ ... 299.00
Wordstar Professional w/GL Demo 189.00
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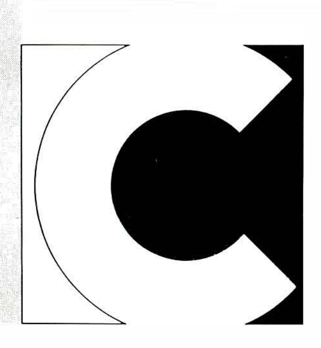
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Color 600 RGB, IBM CGA ... $399.00
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JC-1401P3A Multi-Sync ... 599.00
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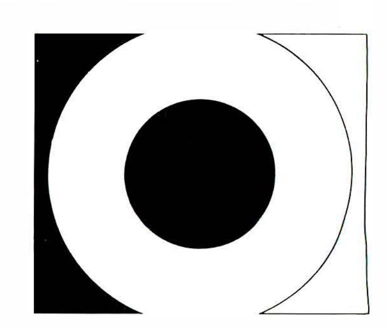
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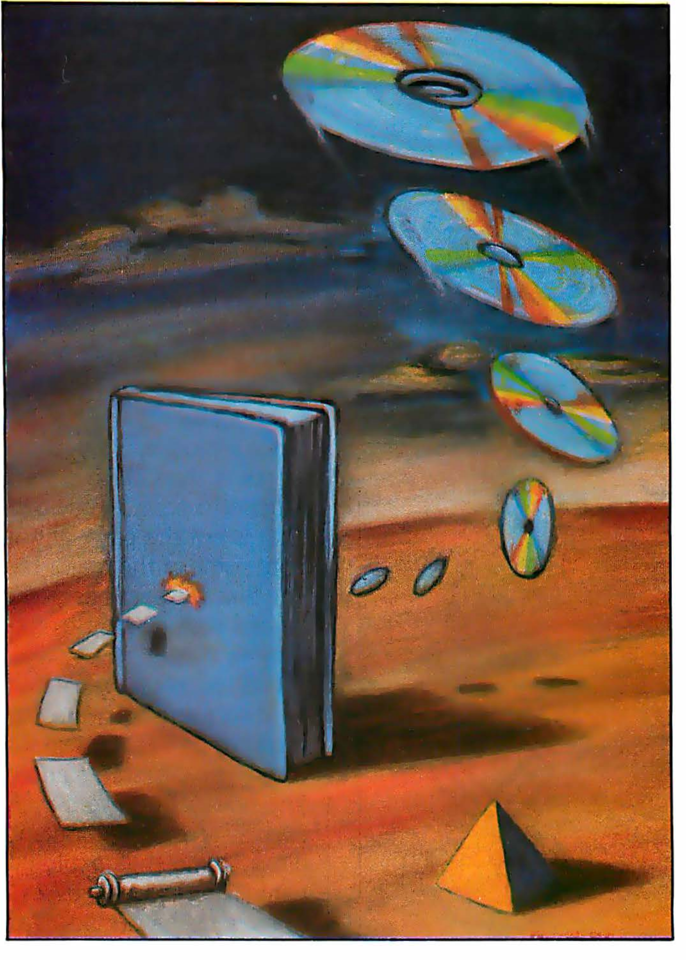
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CD ROM:
THE NEW PAPYRUS
Steve Lambert and
Suzanne Ropiequet, eds.
Microsoft Press
Redmond, WA: 1986
619 pages, $21.95

PROGRAMMING PEARLS
Jon Bentley
Addison-Wesley
Reading, MA: 1986
195 pages, $14.95

ADVANCED UNIX
PROGRAMMING
Marc J. Rochkind
Prentice-Hall
Englewood Cliffs, NJ: 1986
265 pages, $24.95



CD ROM: THE NEW PAPYRUS

Reviewed by
Paul E. Hoffman

Very few technologies come with their own fanfare before they are generally available to the public. The possibilities for CD-ROMs (compact-disk read-only memories), however, have intrigued so many people that the announcements and pronouncements on their future have preceded their commercial use. Industry prognosticators often use phrases like "revolutionary medium" and "huge acceptance" when they discuss CD-ROMs.

CD ROM: The New Papyrus is a hefty collection of papers on all aspects of CD-ROMs, ranging from the technical aspects of how data is stored and retrieved to the commercial aspects of CD-ROM technology. The authors of the papers are active in the CD-ROM industry, and they speak with the authority and enthusiasm that you would expect from people in a cutting-edge field. Fortunately, *The New Papyrus* is not simply a glowing report of how wonderful the CD-ROM will be; it includes a number of skeptical views and warnings about what needs to be done to encourage consumer acceptance of the product.

Overview

CD-ROMs are very similar to audio compact-disk players except that they hold data instead of music (for an extended discussion of CD-ROMs, see the May BYTE theme articles). A single CD-ROM disk can hold more than 500 megabytes of information, or half a billion characters of text. Unlike floppy disks, CD-ROM disks can be read from but not written to. These two features, huge storage capacity and no capability for modification, force hardware and software manufacturers to treat CD-ROMs very differently from current magnetic media.

The New Papyrus covers a wide latitude of subjects and is thus a useful reference both for people new to the field and for those who already know something about it. Forty-five articles are arranged into sections by topic. The structure of the book makes it easy for readers to skip the familiar parts and get to the meat of each article. While some articles are highly technical, many are simply theoretical discourses on the future of CD-ROMs.

The book's introduction offers a useful overview of the current state of the CD-ROM industry. It includes a fascinating article by Vannevar Bush, written in 1945, that predicted the technology of the CD-ROM medium before computers were even commercially available. The second section on the CD system covers the nuts-and-bolts technical issues of CD-ROM hardware and file systems.

Other sections of *The New Papyrus* cover the steps in-

(continued)

ILLUSTRATED BY JOE RUTT

volved in producing a CD-ROM (it's significantly more complicated than producing a floppy disk) and designing the data that goes on CD-ROMs. The authors of these sections explain in great detail the salient features of CD-ROMs that must be addressed before you can create a CD-ROM. Even though CD-ROM disks contain much more information than floppy disks, it takes longer to find information on a CD-ROM drive than with even an inexpensive floppy disk drive. This means that manufacturers must spend a great deal of time analyzing the best way to arrange the information on the disk before putting their data on a master for duplication. On the other hand, this necessity means that you can arrange data "neatly," which is more difficult on media like floppy disks.

The book's final sections cover the future of CD-ROMs in publishing and other applications. The publishing section discusses the importance of computer display technology to the public acceptance of CD-ROMs, since most people are happier with books on paper than on a computer screen. Most of the applications in the last section discuss CD-ROMs as giant databases for specific fields such as library science, medicine, and law. The use of CD-ROMs in vehicle navigation suggests the unexpected places that we may find CD-ROMs in the near future.

COVERAGE

Since almost every author represented in *The New Papyrus* works in the CD-ROM industry, you might expect all the articles to paint a rosy picture of the future of CD-ROMs. That is not the case, although many authors chose to ignore some of the major technical difficulties of CD-ROMs. The first two sections of the book were especially well balanced with respect to the strengths and weaknesses of the medium.

The technical articles go into great detail about both hardware and software. Instead of glossing over the technical points, *The New Papyrus* presents detailed descriptions of the servo systems and optics of the CD-ROM readers. The book also covers many system-level software issues such as error detection and correction and how to design file systems that exploit the medium's strengths while minimizing its weaknesses. You may find that the 60 pages of technical information alone are worth the price of the book. Other sections also contain technical detail that many readers are unaccustomed to in a book that is supposed to be an overview of a new technology. For example, the article on cartographic databases includes the data structures for the maps that the authors describe.

Another example is the article on compressing digitized images; the author ably describes the technical problem and solution to getting as many images as possible onto a CD-ROM disk. Unfortunately, other authors ignored the technical aspects of the system when they wrote their articles and ended up describing systems that would be excessively slow and clunky due to the long seek time of CD-ROM readers.

You may find *The New Papyrus* interesting reading if only to see the discrepancy between some of the suggested

(continued)

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applications and the limitations of the medium. It is clear that many authors were enamored of the capacity and ignored the access-speed problems. Only a few of the articles address how the CD-ROM will fit in with the current state of computers where users expect to be able to save information in their own formats for future use. Some authors assumed that consumers would want to be able to access vast quantities of data on a computer, while others noted that the assimilation of computers has already slowed and that the expected boom in electronic publishing has failed to materialize to the extent predicted a few years ago.

The New Papyrus describes the important features of CD-ROM use. A great deal of space is devoted to a discussion of how the user will interact with such a large quantity of data. Appropriate warnings are given to people designing CD-ROM applications: If they do not do a great deal of planning, their products will go unused. Since many of the proposed applications for CD-ROM technology involve people who haven't used computers before, the user interface for handling such a huge amount of data will be very important.

Some of the articles go off on tangents that detract from the overall quality of the book, but they are easy to skip. Most of the book is well grounded in facts and concepts that the readers can use. One criticism, though, is that the authors' biographies are at the end of the articles instead of at the beginning. Many articles describe commercial products, and it is disconcerting to find at the end of an article that some of the products described are produced by the author's company. While some authors are candid about their company affiliations, others slip in references to their products without indicating their legitimate biases about them. The skeptical reader should read the author biographies before reading the articles.

SUMMARY

CD ROM: The New Papyrus contains enough information to give any reader an in-depth view of the CD-ROM market. Considering how few CD-ROM players are in commercial use, this collection covers an incredible amount of information from a wide variety of sources. It will be a valuable reference over the next few years as CD-ROM technology matures.

Paul E. Hoffman (2000 Center St., Suite 1024, Berkeley, CA 94704) writes and edits books. He holds two degrees from MIT, *and he is the editor of* Text In Computers, *a new scholarly journal.*

PROGRAMMING PEARLS
Reviewed by Michael O'Neill

Jon Bentley's column "Programming Pearls" has appeared in the journal *Communications of the Association for Computing Machinery* (*CACM*) since 1983. This popular feature presents interesting and useful programming tech-

(continued)

niques gathered from a variety of sources: journals, programmers' folklore, the author's own experience, and that of his friends and correspondents. *Programming Pearls* consists of revised and expanded versions of thirteen of these columns.

AMPLE CHOICE

Bentley usually presents more than one application of each technique; Column 2 and Problem 2.2, for example, explain some not widely known applications of the widely known binary search technique. Bentley often presents more than one way of solving a given problem as well. For instance, in Column 11 he shows five different ways to perform one task, and he details the conditions under which one or another approach would be superior.

Programming Pearls contains some awfully clever tricks. My favorite is the combination of tricks that is used to store the dictionary for a commercial spelling checker program. Doug McIlroy, the program's author, managed to store 75,000 English words in 52K bytes, less than a fifth of the space required for storing the dictionary as ASCII characters. (Sorry, I don't have the space here to tell you how he did it.) Column 2, "Aha! Algorithm," and its associated problem set contain several very clever tricks, too. There are many more. But Bentley does not present cleverness for the sake of cleverness; each of his tricks provides increased efficiency, comprehensibility, or both.

The book, however, is not just a bag of tricks; Bentley has tried, with some success, to organize his material into a coherent whole. While there may be many books on programming, there are few collections of tricks of the trade. *Programming Pearls* is the best collection I've seen.

STRUCTURAL SCHEMAS

The book is divided into three parts: "Preliminaries," "Performance," and "The Product." The first section contains material dealing with what might be called pre- and post-programming issues. Here Bentley offers program planning and verification techniques. "Performance" contains the columns that concern ways of producing efficient programs. "The Product" consists of four columns in which Bentley presents applications of the previously given techniques to more involved programs such as the spelling checker. This organizational scheme is very approximate; there is considerable overlap of material from section to section, and the assignment of columns to sections is somewhat arbitrary.

Bentley imposes a second form of organization by highlighting certain motifs that recur throughout *Programming Pearls*. Each column includes a section called "Principles" in which the author lists the motifs that appear in the column. Some of these motifs are programming techniques such as binary search; others are general principles such as "Keep it simple" and "Work on the right problem." This organizational scheme effectively links the individual columns together and is more successful than the previously mentioned three-part schema.

Bentley includes a section of hints and solutions to

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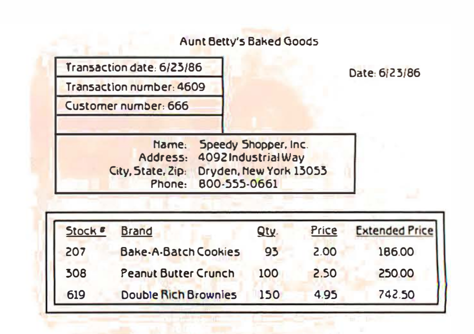
A typical DBMS user's screen, after the 497th line of code.

```
SELECT ALL FROM callrpt SORTED BY calldate WHERE ...

—Choose an operator to combine conditions—Choose (Done) when done—
   AND   OR   AND   NOT   OR   NOT   (Done)

        Column     Operator   Value
        district   EQ         Boston
OR      district   EQ         NewYork
AND     calldate   GT         March 12, 1985
AND     comment    contains   American Baking Company
```

An R:BASE System V Prompt-By-Example (PBE) screen. With PBE's query capabilities, you can retrieve just the information you need. Without programming.



Aunt Betty's Baked Goods

Transaction date: 6/23/86

Transaction number: 4609

Customer number: 666

Date: 6/23/86

Name: Speedy Shopper, Inc.
Address: 4092 Industrial Way
City, State, Zip: Dryden, New York 13053
Phone: 800-555-0661

Stock #	Brand	Qty.	Price	Extended Price
207	Bake-A-Batch Cookies	93	2.00	186.00
308	Peanut Butter Crunch	100	2.50	250.00
619	Double Rich Brownies	150	4.95	742.50

A data entry screen designed without programming, using Forms EXPRESS.

With most database management software for the IBM PC family and compatibles, you're quickly confronted with a painful reality: the only way to make your package live up to its promise is to learn its programming language. Which can take months. Then you have to write the code, line after frustrating line.

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R:BASE SYSTEM V. IT GIVES NON-PROGRAMMERS POWERFUL PROGRAMS.

With the EXPRESS System in R:BASE System V, you can access powerful features, without programming, that other data management software can't touch.

With Definition EXPRESS, you can build a database structure with advanced features like computed columns, and *searchable* note fields. VIEWS that combine up to five tables in a single, powerful table. Data validation rules that check incoming data for errors. All without programming.

Then you can use Forms EXPRESS to create customized data entry forms. The forms you create can load data into five different tables, linked in One-To-Many relationships. You can also include scrolling regions, custom borders, and custom colors, all without programming.

And with Reports EXPRESS, you can design reports exactly the way you want. And see what they'll look like, right on the screen. To see how complex your reports can be, take a close look at the example at the end of this page.

Finally, you can tie it all together with Application EXPRESS. First, you design your own multi-level system of menus. Your first menu level might look like this:

```
Aunt Betty's Sales Reporting System
   (1) Enter Sales Data
   (2) Edit Sales Data
   (3) Print Daily Sales Report
   (4) File Processing
   (5) Exit
```

For each menu choice, you assign an action. For example, to define menu choice #3, choose the action "PRINT," select the report you just created in Reports EXPRESS, and specify the appropriate data sorting and selection criteria. Then Application EXPRESS automatically writes the program code.

Which means you've just created a very sophisticated program to deliver the full power of your DBMS. And you've done it all without learning how to program. From this point on, every time you want to run a report, all you do is choose item #3. With one simple keystroke, you've got it.

R:BASE SYSTEM V. IT GIVES PROGRAMMERS A POWERFUL ENVIRONMENT.

If you're an experienced programmer, you can use R:BASE System V to tackle the most demanding applications. You can use Application EXPRESS to create prototypes faster than with any other microcomputer-based DBMS.

There's a high-level procedural language, and a full set of relational operators that can leverage up to 80 tables, all of which can be open at once. While you're racing along, a data dictionary

DBMS PROGRAMS
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15 line header (up to 65 lines possible)

Time and date stamping

Page: 1
Date: Tuesday, June 24, 1986
Time: 8:00 am

Supports italics and other special printer commands

Aunt Betty's Baked Goods, Incorporated
California Division
Daily Sales Report
For June 23, 1986
Confidential Information

Four levels of grouping... (up to 10 levels possible)

1 Q1-1986	
2 Southern California	TOTAL SALES
3 Cracker Products	
4 Wheat Crisps	97,536.22
Rye Crackers	235,223.11
Total Cracker Product Sales	332,759.33
Sweet Goods Products	
Bake-A-Batch Cookies	25,006.23
Peanut Butter Crunch	8,623.30
Coconut Macaroons	19,446.90
Double Rich Brownies	113,636.01
Total Sweet Goods Product Sales	166,712.44
Total Sales, Southern California	499,471.77
Northern California	
Cracker Products	
Wheat Crisps	57,406.25
Rye Crackers	175,223.56
Total Cracker Product Sales	232,629.81
Sweet Goods Products	
Bake-A-Batch Cookies	45,146.55
Peanut Butter Crunch	47,123.80
Coconut Macaroons	9,390.99
Double Rich Brownies	517,446.25
Total Sweet Goods Product Sales	619,107.59
Total Sales, Northern California	851,737.40
Total Sales	1,351,209.17

Prints summary line for grouping

Draws boxes anywhere in report

A program to print this report daily, with a one-keystroke menu pick, was developed without programming using R:BASE System V's EXPRESS Technology. Whether you know how to program or not, R:BASE System V is the shortest distance to your data management solution.

THE MOST POWERFUL DBMS FOR ONE USER OR A WHOLE NETWORK— ALL IN ONE PACKAGE.

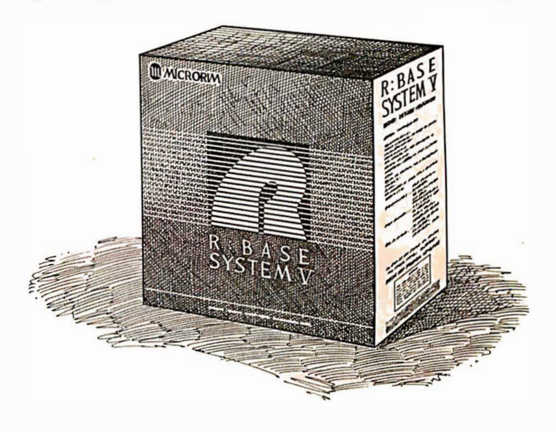
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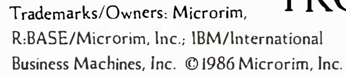
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NEW R:BASE SYSTEM V
FROM MICRORIM





selected problems and a catalog of the algorithms contained in the book (classified by type).

DIFFERENT APPROACHES

I have two suggestions about how to read this book. First, the epilogue, in which Bentley interviews himself, is the best summary of the purpose of the book and the themes that run through it; read it first. Second, each problem set has many practice problems closely related to the material in its associated column. Try to do each problem set before reading the column because it may be too easy afterward.

Jon Bentley has produced a fascinating collection of programming tricks. He obviously enjoys programming, and his enthusiasm and writing skill make this book fun to read as well as educational. By emphasizing recurring motifs, Bentley stresses techniques and rules of thumb that are of general usefulness for writing programs that are correct, fast, compact, and easy to understand and maintain. If you are a programmer who wants to improve the quality of the programs you write, *Programming Pearls* is well worth reading.

Michael O'Neill *(2227 Dwight Way #4, Berkeley, CA 94704) has been programming computers for 20 years.*

ADVANCED UNIX PROGRAMMING

Reviewed by Brian Edgington

Here, at last, is a book that can be put on the shelf next to definitive standards such as Kernighan and Ritchie's *The C Programming Language* (Prentice-Hall, 1978) and Kernighan and Pike's *The UNIX Programming Environment* (Prentice-Hall, 1984). Marc Rochkind has given us a technically coherent and complete guide to programming in the UNIX operating systems, System III, System IV, Berkeley 4.2, and XENIX. He has demonstrated the differences in programming techniques between the different systems and has conveniently included information relating specifically to XENIX.

SYSTEM CALLS

Most programmmers write applications for end users that require little, if any, direct or visible interaction with the operating system. In fact, most of the common operating systems other than UNIX require that system calls and operating system interfaces be written in assembly language, a skill few COBOL or FORTRAN programmers have or want. The UNIX operating system requires the full use of system calls to display its entire range and flavor. These calls give the programmer very fine control over the operating system and the functionality of the programs.

The chapters divide the system calls into logical groups. These include a review of fundamental concepts, file I/O, terminal I/O, signals, processes, and interprocess communication. The book concludes with a collection of miscellaneous system calls and two appendixes that contain a

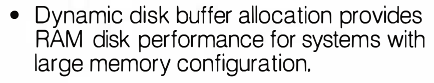
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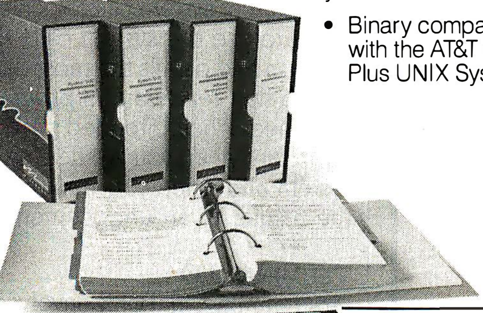
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Over 200 utilities come standard.

Grep, awk, sort, split, cut, paste, vi and ed (and many more) now let you search and modify files, make use of electronic mail, emulate terminals, calculate electronically, convert data and publish.

SYSTEM V/AT is more than a look-alike. It was derived from AT&T's own UNIX System V release 2 iAPX286. It thereby contains standard System V features the competitors don't support, such as the powerful symbolic debugger, sdb, the shell-layering job-control facility and the F77 Fortran compiler, as well as programming tools such as ctrace, cflow, and bs. Also standard is File System Hardening which greatly reduces data loss in a power failure.

Want some more features?

- Console driver providing ANSI terminal interface for monochrome, CGA, Hercules and EGA cards.
- *Multiple Virtual* consoles allow up to four virtual windows of operation.
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So, how do we do it?

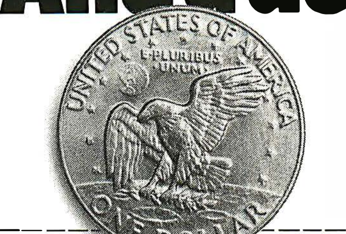
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summary of subroutines and System V process attributes.

An excessive number of technical books on the shelves today spend an inordinate amount of time telling you "how to." There are books on programming and systems design that contain hundreds of lines of code but spend very little time explaining why and when to use the skills they teach. *Advanced UNIX Programming* goes beyond the normal how-to mindset and teaches the philosophy behind the different system calls. Rochkind very capably describes when to use the system calls that parallel each other in function and details the most common side effects of each call so that readers and programmers can decide which best meets their intended purpose and goals. This is very important when you are dealing directly with the operating system and when you want to avoid hours of debugging the results of an undocumented "feature."

TERMINAL I/O

Programming in UNIX involves the use of some complicated techniques to exhaust all the features available with a true multitasking system. And since this is still an evolving operating system, the ability to add or modify existing support and application programs that depend on the hardware peculiarities of new and enhanced peripherals is of primary importance to the systems programmer.

Terminal I/O is a complex topic that is handled very thoroughly in a chapter by itself. Terminal communications in UNIX take place through programs called device drivers. The user makes a request to the kernel for data transfer through a particular device, and that request is passed off to the appropriate device driver for processing, completion, and error detection and recovery if necessary or appropriate. This means the device driver must be very comprehensive and must fully use a great many of the available system calls.

The chapter on terminal I/O is indicative of the completeness and depth found throughout the book. With more than three structure types and 50 different flags to deal with in working with the typical communications line, the information is well presented and easily understood.

MULTITASKING AND PROCESSES

A full chapter is devoted to multitasking, one of the main features of the UNIX operating system. Two chapters are devoted to interprocess communication. Rochkind takes the reader through a tutorial on the environment and explains how to use system calls to read and write to the process environment, a feature that allows users to customize features of their shell. He also explains how to use other application programs that read environment variables.

Since almost everyone who uses UNIX is familiar with the shell and how it operates, the author demonstrates the system calls exec, fork in its various forms, and related calls by building a small shell. The detail and complexity of the shell and its features are developed and matured as more and more system calls are discovered. This is an excellent way to learn to use the system calls because it

(continued)



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PC-DOS, MS-DOS, CP/M-86, Macintosh, Amiga, Apple II, CP/M-80, Radio Shack, Commodore, XENIX, ROM, and Cross Development systems

MS-DOS, PC-DOS, CP/M-86, XENIX, 8086/80x86 ROM

Manx Aztec C86

"A compiler that has many strengths . . . quite valuable for serious work"

Computer Language review, February 1985

Great Code: Manx Aztec C86 generates fast executing compact code. The benchmark results below are from a study conducted by Manx. The Dhrystone benchmark (CACM 10/84 27:10 p1018) measures performance for a systems software instruction mix. The results are without register variables. With register variables, Manx, Microsoft, and Mark Williams run proportionately faster, Lattice and Computer Innovations show no improvement.

	Execution Time	Code Size	Compile/ Link Time
Dhrystone Benchmark			
Manx Aztec C86 3.3	34 secs	5,760	93 secs
Microsoft C 3.0	34 secs	7,146	119 secs
Optimized C86 2.20J	53 secs	11,009	172 secs
Mark Williams 2.0	56 secs	12,980	113 secs
Lattice 2.14	89 secs	20,404	117 secs

Great Features: Manx Aztec C86 is bundled with a powerful array of well documented productivity tools, library routines and features.

Optimized C compiler	Symbolic Debugger
AS86 Macro Assembler	LN86 Overlay Linker
80186/80286 Support	Librarian
8087/80287 Sensing Lib	Profiler
Extensive UNIX Library	DOS, Screen, & Graphics Lib
Large Memory Model	Intel Object Option
Z (vi) Source Editor -c	CP/M-86 Library -c
ROM Support Package -c	INTEL HEX Utility -c
Library Source Code -c	Mixed memory models -c
MAKE, DIFF, and GREP -c	Source Debugger -c
One year of updates -c	CP/M-86 Library -c

Manx offers two commercial development systems, Aztec C86-c and Aztec C86-d. Items marked -c are special features of the Aztec C86-c system.

Aztec C86-c Commercial System	**$499**
Aztec C86-d Developer's System	**$299**
Aztec C86-p Personal System	**$199**
Aztec C86-a Apprentice System	**$49**

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Third Party Software: There are a number of high quality support packages for Manx Aztec C86 for screen management, graphics, database management, and software development.

C-tree $395	**Greenleaf $185**
PHACT $250	**PC-lint $98**
HALO $250	**Amber Windows $59**
PRE-C $395	**Windows for C $195**
WindScreen $149	**FirsTime $295**
SunScreen $99	**C Util Lib $185**
PANEL $295	**Plink-86 $395**

MACINTOSH, AMIGA, XENIX, CP/M-68K, 68k ROM

Manx Aztec C68k

"Library handling is very flexible . . . documentation is excellent . . . the shell a pleasure to work in . . . blows away the competition for pure compile speed . . . an excellent effort."

Computer Language review, April 1985

Aztec C68k is the most widely used commercial C compiler for the Macintosh. Its quality, performance, and completeness place Manx Aztec C68k in a position beyond comparison. It is available in several upgradable versions.

Optimized C	Creates Clickable Applications
Macro Assembler	Mouse Enhanced SHELL
Overlay Linker	Easy Access to Mac Toolbox
Resource Compiler	UNIX Library Functions
Debuggers	Terminal Emulator (Source)
Librarian	Clear Detailed Documentation
Source Editor	C-Stuff Library
MacRam Disk -c	UniTools (vi,make,diff,grep) -c
Library Source -c	One Year of Updates -c

Items marked -c are available only in the Manx Aztec C86-c system. Other features are in both the Aztec C86-d and Aztec C86-c systems.

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Aztec C68k-p Personal System	**$199**
C-tree database (source)	**$399**
AMIGA, CP/M-68k, 68k UNIX	**call**

Apple II, Commodore, 65xx, 65C02 ROM

Manx Aztec C65

"The AZTEC C system is one of the finest software packages I have seen"

NIBBLE review, July 1984

A vast amount of business, consumer, and educational software is implemented in Manx Aztec C65. The quality and comprehensiveness of this system is competitive with 16 bit C systems. The system includes a full optimized C compiler, 6502 assembler, linkage editor, UNIX library, screen and graphics libraries, shell, and much more. The Apple II version runs under DOS 3.3, and ProDOS, Cross versions are available.

The Aztec C65-c/128 Commodore system runs under the C128 CP/M environment and generates programs for the C64, C128, and CP/M environments. Call for prices and availability of Apprentice, Personal and Developer versions for the Commodore 64 and 128 machines.

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Aztec C65-d Apple DOS 3.3	**$199**
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Distribution of Manx Aztec C

In the USA, Manx Software Systems is the sole and exclusive distributor of Aztec C. Any telephone or mail order sales other than through Manx are unauthorized.

Manx Cross Development Systems

Cross developed programs are edited, compiled, assembled, and linked on one machine (the HOST) and transferred to another machine (the TARGET) for execution. This method is useful where the target machine is slower or more limited than the HOST, Manx cross compilers are used heavily to develop software for business, consumer, scientific, industrial, research, and educational applications.

HOSTS: VAX UNIX ($3000), PDP-11 UNIX ($2000), MS-DOS ($750), CP/M ($750), MACINTOSH ($750), CP/M-68k ($750), XENIX ($750).

TARGETS: MS-DOS, CP/M-86, Macintosh, CP/M-68k, CP/M-80, TRS-80 3 & 4, Apple II, Commodore C64, 8086/80x86 ROM, 68xxx ROM, 8080/8085/Z80 ROM, 65xx ROM.

The first TARGET is included in the price of the HOST system. Additional TARGETS are $300 to $500 (non VAX) or $1000 (VAX).

Call Manx for information on cross development to the 68000, 65816, Amiga, C128, CP/M-68K, VRTX, and others.

CP/M, Radio Shack, 8080/8085/Z80 ROM

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"I've had a lot of experience with different C compilers, but the Aztec C80 Compiler and Professional Development System is the best I've seen."

80-Micro, December, 1984, John B. Harrell III

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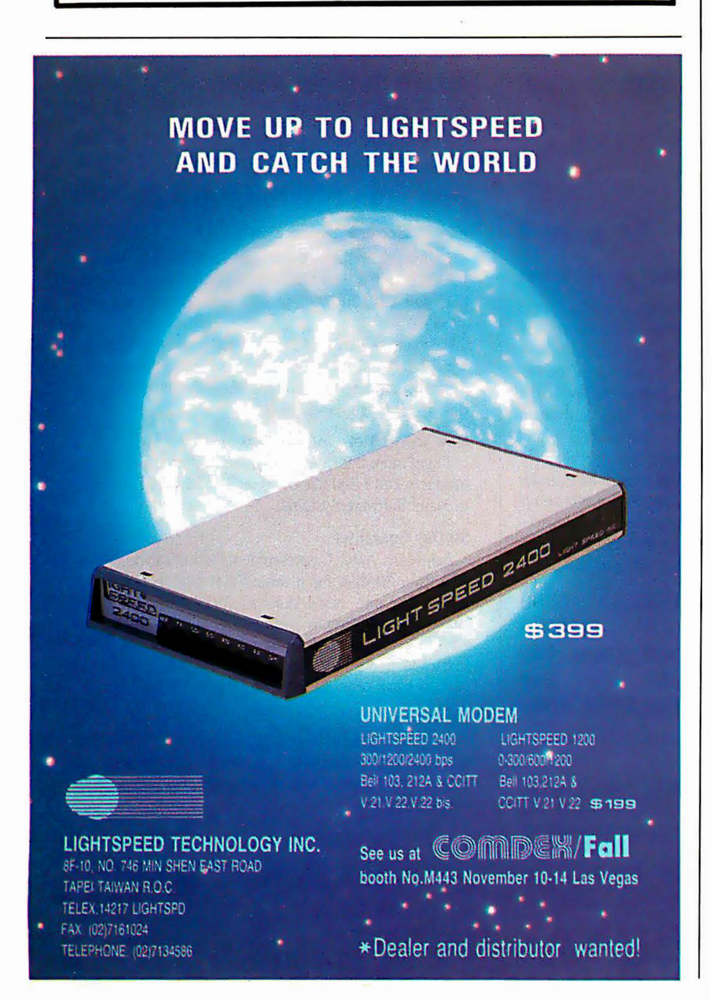
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BOOK REVIEWS

Advanced UNIX Programming *is an invaluable aid in creating more efficient programs.*

exercises the programmer's skill and imagination in a learn-by-doing situation.

Although this book is directed toward experienced programmers who have already perfected their own bad habits, the style and consistency of the code examples will be a help to anyone who chooses to use this work as a guide or text.

INTERPROCESS COMMUNICATION

By the end of the fifth chapter, the author has covered most of the system calls used in programming and still has four more chapters to go. I say most because the calls used in interprocess communications are rarely implemented because of the lack of understandable documentation available before now.

Pipes are generally understood at a lower level because shell programmers have always been able to use the "¦" symbol to connect the output of one program with the input of another. In completing the shell started in the chapter on processes, Rochkind goes into detail on the construction and use of pipes. Bidirectional pipes are explained, along with examples of where a pipe can be used and several examples of where pipes should not be used.

FIFOs, semaphores, and shared memory are the advanced interprocess communications techniques that have been developed and carried across the System III and System V families. Communications that were developed for the Berkeley family are not as portable or as easily understood as AT&T's and are not covered in this book.

FIFOs are fancy pipes with names and attributes like files so that they can be used by different processes, and quite a bit of time is spent developing the proper use of FIFOs in a database management system application. The coverage of this topic is quite lively, and several primitives or functions are developed and supplied to the readers for their toolboxes.

I have covered only half the information in this book; its depth and comprehensiveness go farther. The information is presented with thought and humor, and the author displays a genuine understanding of the subject matter. There are exercises at the end of each chapter that can aid in developing skills in using system calls effectively. No matter what version of UNIX you work with, the information in *Advanced UNIX Programming* will be an invaluable aid in creating more efficient programs.

Brian Edginton (551 Ramona Ave., Salt Lake City, UT 84105) is a consultant for UNIX, XENIX, PC-DOS, *and networking applications.* ■



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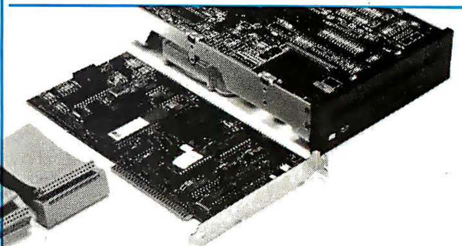
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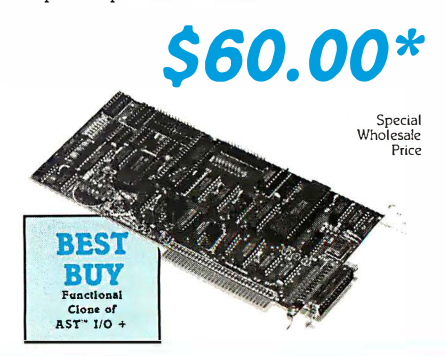
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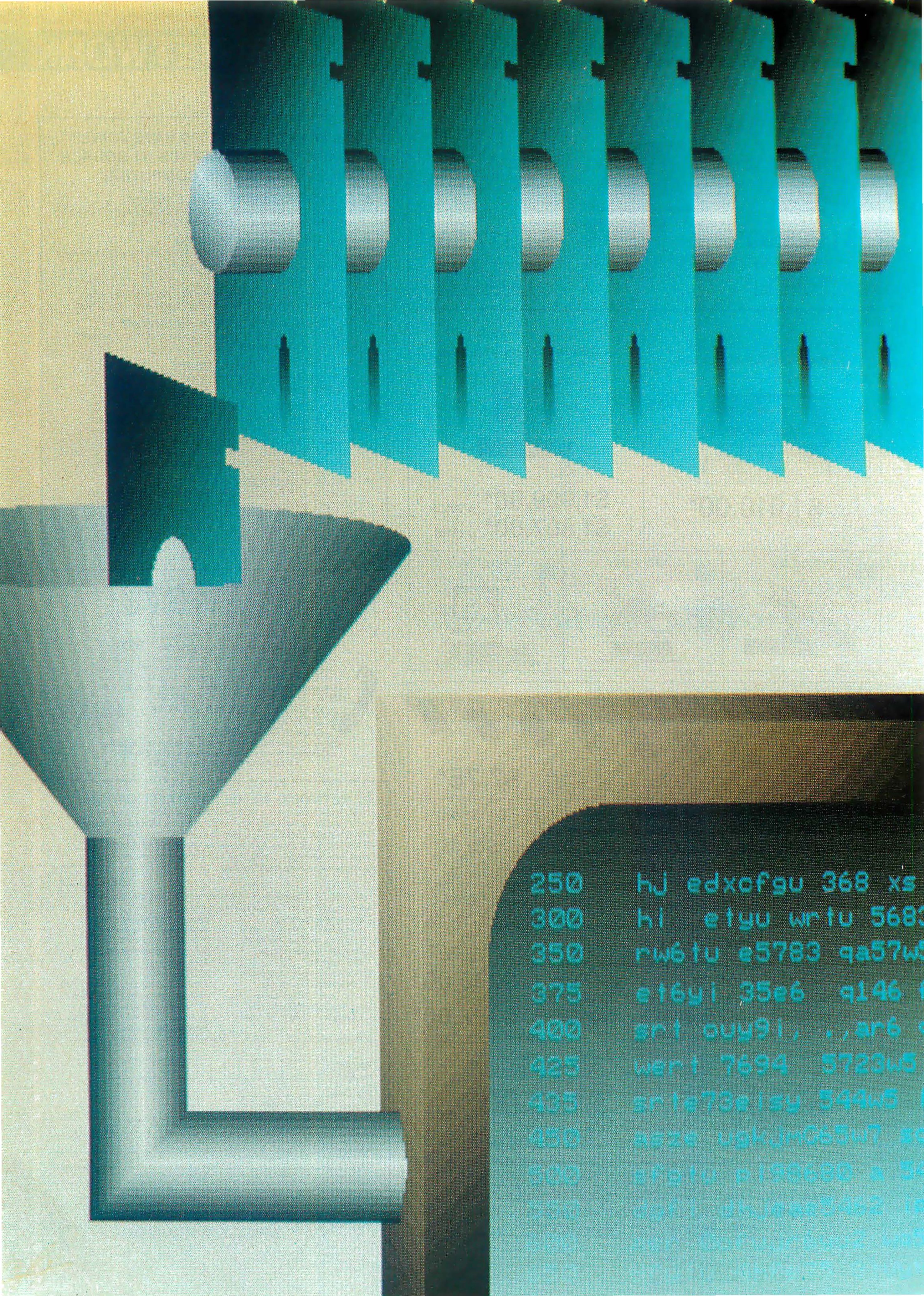
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Features

THIS MONTH OUR FEATURES SECTION starts with a Product Preview. The product in question, the Apple II GS, is the most recent incarnation in the rather long and curious line of Apple IIs. In their article, Senior Technical Editor Gregg Williams and Technical Editor Richard Grehan examine a preliminary version of the machine and consider its potential. A complete review of the Apple II GS will follow in a subsequent issue.

Back in February 1985, Steve Ciarcia's Circuit Cellar project was a serial EPROM programmer. Steve intended it as an experimenter's project that would satisfy a certain core of supporters yet enlighten the larger audience of readers about EPROM programming in general. This proved to a miscalculation. It was much better received than Steve thought it would be. Unfortunately, he hadn't arranged to have it made into a printed circuit board. To make up for this, Steve returns this month with an improved serial EPROM programmer that includes an on-board CPU and intelligent firmware.

All useful programs need storage to go about their business, and Jonathan Amsterdam's "Safe Storage Allocation" explains how to avoid the dangers involved in allocating memory. This Programming Project focuses on four storage allocators that are available to readers in a variety of formats.

In our ongoing coverage of 68000 machines, this month we look at the Commodore Amiga. David D. Thiel's "Sound and the Amiga" explores the Amiga's enhanced, hardware-assisted, digital-to-analog converter approach to sound. Within processor and RAM limitations, says the author, you can do whatever musical flights of fancy you are clever enough to conceive.

Finally, in his October Programming Insight, "A Useful Property of 2^n," Robert C. Arp Jr. discusses how he solved the problem of a shortage of user flags by exploiting a property of summations of 2^n.

THE APPLE II GS

The 65C816 processor brings the Apple II into the 16-bit world.

Editor's note: The following is a BYTE product preview. It is not a review. We provide an advanced look at this new product because we feel it is significant. A complete review will follow in a subsequent issue.

The Apple II has a curious history. It was originally designed by Steve Wozniak and Alan Baum in 1976 as a homebrew computer that squeezed maximum features out of minimum parts. Over the years, it evolved into the Apple II+, then the IIe, then the IIc. Once, Apple tried to kill it off with the Apple III (which itself died) and, later, with the Macintosh and the IIc. Despite corporate attempts to ignore it and retard its evolution, the Apple II continued to bring in the major part of Apple's income. Finally, in May 1984 Apple acknowledged the reality of the Apple II's success when it titled its day-long introduction of the Apple IIc "Apple II Forever." (Despite Apple's wishes to the contrary, the IIe continued to sell better than the non-expandable IIc—people wanted their expansion slots.) By mid-1985, though, the Apple II began to lose its sales appeal, and Apple engineers were already working on a product called, at various times, Phoenix, Columbia, Cortland, and Granny Smith: the Apple II GS.

The Apple II GS looks back to the past and forward to the future, and the machine might best be summarized by saying that it takes a giant step in both directions. Its new styling and modularity (see photo 1) foreshadows a day when Macintosh and Apple II products will use the same keyboard and 3½-inch disk drives.

SYSTEM DESCRIPTION

Here are the most important features of the Apple II GS:

- **Apple II compatibility:** The Apple II GS will run most Apple II software and expansion cards. It can run at normal Apple II speed or at a higher rate that makes most software run two to three times faster. [*Editor's note: In this article, "Apple II" refers to the traditional Apple II computer as defined by the Apple II, II+, IIe, and IIc.*] The Apple II GS composite video signal has been corrected so that it will be recorded correctly by a videotape recorder. Apple IIe owners can upgrade to complete II GS compatibility by replacing the motherboard and back/bottom plate with a II GS retrofit kit.
- **A 16-bit, 6502-compatible processor:** With a 16-bit address bus and 8 "bank address" lines, the Western Design Center's W65C816 can address 256 banks of 64K bytes each, for a total of 16 megabytes. It can also go into a 6502 mode, where it emulates the 65C02A used in the Apple IIe and IIc. The processor's accumulator, stack pointer, and all its registers are 16 bits wide, and its instruction set includes 11 new addressing modes.
- **Greatly expanded memory capacity:** The machine's architecture reserves space for 8 megabytes of user RAM and 1 megabyte of system ROM. It comes with 256K bytes of RAM, 128K bytes of system ROM, and 64K bytes of dedicated sound-waveform memory, but you will have to wait for new programs to use most of the memory above the first 128K bytes. Apple currently has plans for 1- and 4-megabyte expansion cards, although an 8-megabyte card is possible.
- **New graphics capabilities:** The Apple II GS adds two "super hi-res" graphics modes: 200 by 320 pixels with a 16-color palette and 200 by 640 pixels with a 4-color palette; the colors come from a color set of 4096. The machine can use up to 16 palettes per screen and change palettes and resolution on a line-by-line basis. Programmers can use two experimental modes: a 640- by 200-pixel, 16-color (with restrictions) palette mode, and a high-speed "fill mode" variation of the 200 by 320, 16-color mode.
- **New sound capabilities:** The 32-voice Ensoniq Digital Oscillator Chip (DOC), used in the Ensoniq Mirage sampled-sound music synthesizer, and system firmware can drive the

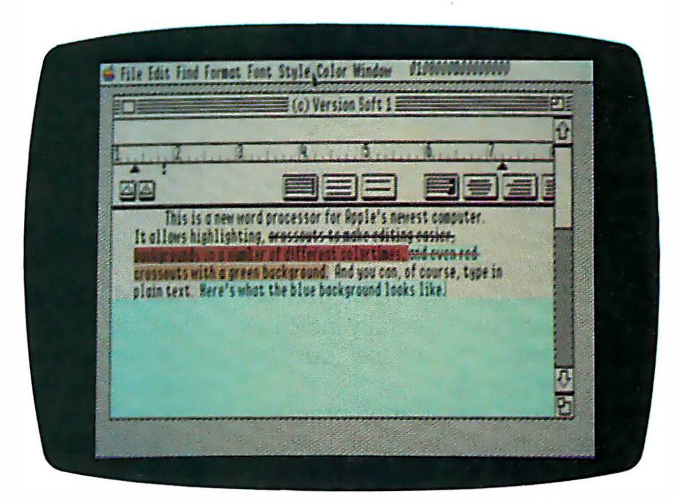
(continued)

Gregg Williams is a senior technical editor at BYTE; *he bought his first Apple II+ in 1980 and now owns an Apple IIe. Richard Grehan, who has owned an Apple II+ since 1985, is a technical editor at* BYTE. *They can be reached at One Phoenix Mill Lane, Peterborough,* NH 03458.

BY GREGG WILLIAMS AND RICHARD GREHAN



Deluxe Paint drawing program. (Photo by Electronic Arts.)



Writer's Choice Elite word processor. (Photo by Activision Inc.)

SCREEN DRAWING BY MITCHELL RICE

Photo 1: *The Apple* II GS.

PHOTOGRAPHY BY PAUL AVIS

chip to produce up to 15 musical "instruments."

- Mouse, keyboard, and disks: A one-button mouse and a detachable keyboard with keypad are standard equipment. The Apple II GS does not have an internal disk drive, but you can daisy-chain up to two 800K-byte 3½-inch drives and two 140K-byte 5¼-inch drives to the disk drive port on the rear panel. The system software will come on 3½-inch disks, which silently but forcefully indicates Apple's intent to phase out the 5¼-inch floppy disk.
- The Toolbox: Application programs can use built-in code (some in ROM, some in RAM) to provide a mouse-driven desktop environment and orderly use of system resources.
- The Finder: Finder software, supplied with the basic system, allows users to interact with disks and files using windows, icons, and a mouse-driven cursor (as popularized by the Apple Macintosh).
- Desk accessories: The Apple II GS makes available Macintosh-like desk accessories; some are available from all programs, and others work only with programs specifically designed for the Apple II GS. The Control Panel, accessible from any program, allows the user to change the date, slot assignments, operating speed, and similar parameters.
- New languages and tools: For the software developer, Apple will offer a 6502/65C02/65816 assembler and versions of C and Pascal; the three languages share a standard editor and linker and allow object code modules from any source to be used together. For the hobbyist, Apple has extended the Apple IIe monitor to work in the Apple II GS 16-bit environment and has added new functions to it.
- No enhanced, built-in language: Like the Macintosh (and unlike most other computers), the Apple II GS contains no built-in language (such as Microsoft BASIC) that interacts with the machine's new features. Applesoft BASIC is available in system ROM, but it has no way of directly interacting with the new Apple II GS features.
- A new 16-bit operating system: ProDOS 16 extends Apple's ProDOS (which runs on the Apple II+, IIe, and IIc) to be the standard Apple II GS operating system; it runs on the 65816 in native 16-bit mode, is functionally similar to the 8-bit ProDOS, and shares an identical file structure with ProDOS. Apple has also made slight modifications to the 6502-based ProDOS so that it will run on the Apple II GS's Apple II emulation mode; this operating system is named ProDOS 8.

Two Machines

The case of an Apple II GS contains, in a sense, two machines: the full Apple II GS, with all its memory and new features, and a 128K Apple IIe. Much of this article will explain the design elements that allow these two "machines" to exist together. You may want to refer to figure 1, which is a block diagram of the Apple II GS.

The Mega II

The Mega II is a custom CMOS chip containing about 3000 gates and a 2K-byte by 8 ROM (for the character generator). It replaces the following chips from the Apple IIe and IIc: character generator ROMs for eight languages, several TTL chips that perform logic functions, and the MMU (memory management unit), IOU (input/output unit), TMG (timing generator), and GLU (general logic unit) custom chips.

In previous Apple II designs, the refreshing of memory was tied directly to the Apple II video mode. The Mega II includes an 8-bit counter for refreshing the 128K bytes of (slow) memory associated with the Apple IIe/IIc model; it does five cycles of RAM refresh during the horizontal retrace of each video scan line and refreshes the 128K bytes of memory in 3.25 milliseconds. By taking care of RAM refresh, the Mega II chip opens the Apple II design to new video modes that were impossible before.

Speeding Up the II GS

The Apple II GS designers had many conflicting goals. They wanted to make a machine that runs as much existing Apple II software as possible and to make it run software (both old and new) faster than on an Apple II. In order to accomplish this, they changed the memory map and employed a technique called *shadowing*.

Figure 2 shows the Apple II GS memory map. Remember that many memory areas in the Apple II are special; the memory-mapped "soft switches" in the C000-C0FF hexadecimal region control many key functions, interaction with the peripheral cards occurs through locations in the C100-CFFF hexadecimal region, and several areas of memory determine what graphics and/or text are shown on the video display. Many of these areas are limited by the original Apple II design to being accessed at 1 MHz.

A straightforward expansion of the Apple II design would put the slow memory in banks 00 and 01, their location in the Apple IIe and IIc. (A bank is defined as the 64K-byte address space from hexadecimal location XX0000 to XXFFFF. Actually, the two 64K-byte banks of memory in the Apple IIe and IIc are called simply the *main* and *auxiliary* banks, but you can imagine the bank select as the 17th bit of the corresponding Apple II GS memory address.)

Instead, the designers put the slow memory (with the corresponding control circuitry) in banks E0 and E1 hexadecimal and assigned fast memory to banks 00 through 7F. This gives you 8 megabytes of *linearly addressed* memory (something new to Apple II programmers), and all existing Apple II programs (which must run in banks 00 and 01) will run in fast, not slow, memory. (The 65C816 runs at 2.8 MHz, but the overhead of dynamic memory refreshing slows the average speed of RAM memory access to about 2.5 MHz; ROMs are accessed at the full 2.8-MHz speed.)

This scheme gives us speed but not compatibility. Programs that do I/O using the peripheral slots and video display write to addresses in banks 00 and 01, but the hardware they need to interact with is tied to the slow memory in banks E0 and E1 hexadecimal. How can we get this scheme to work?

The answer is shadowing. The Apple II GS engineers designed the Fast Processor Interface (FPI) custom chip to monitor any attempt to write to the area to be shadowed (in bank

(continued)

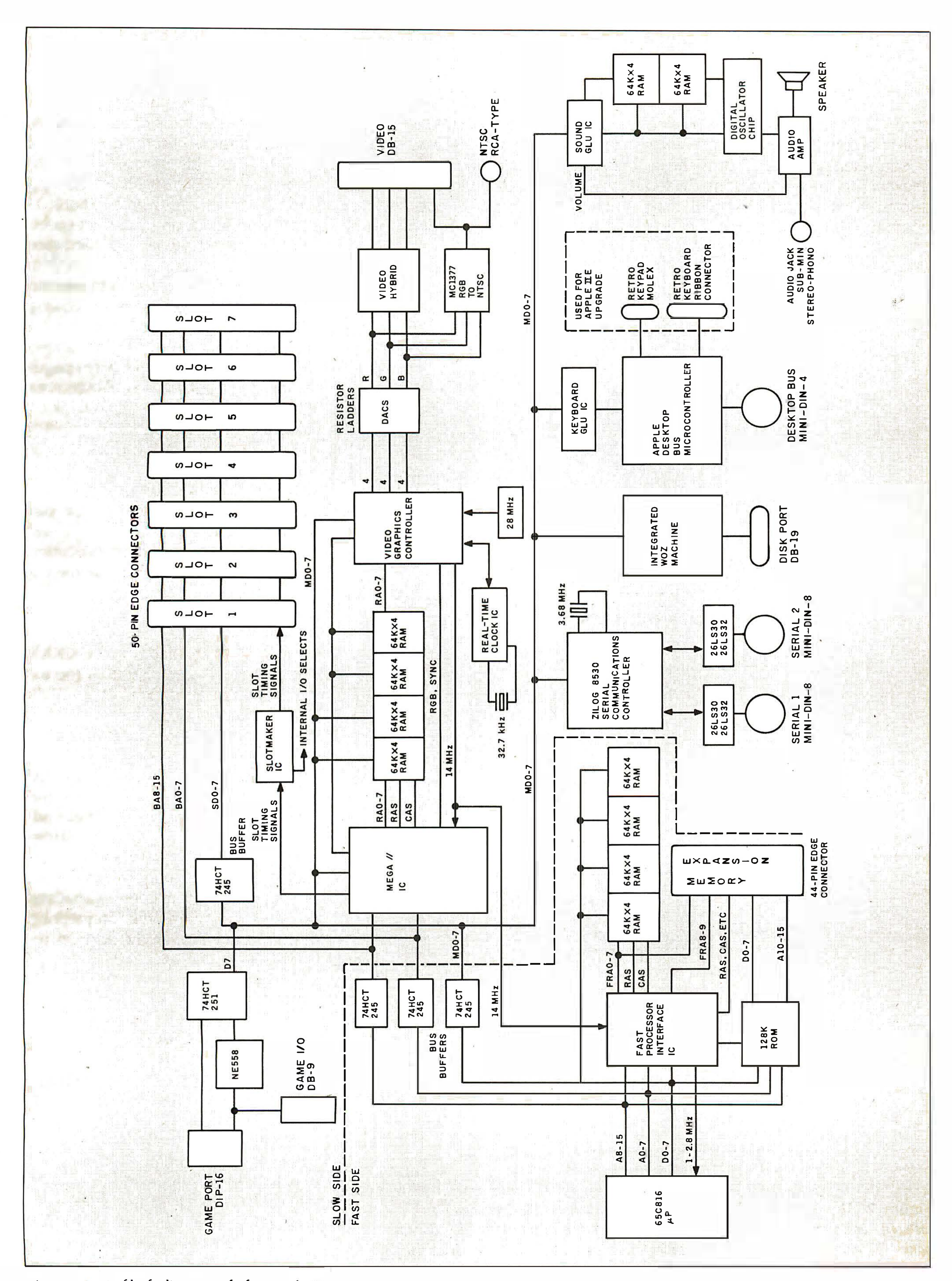


Figure 1: *A block diagram of the Apple II GS.*

00 or 01), then slow itself down to 1 MHz and write to the location *and* its equivalent in bank E0 or E1 hexadecimal. In many locations (video display memory, for example) read operations from the same location have no timing constraints and can proceed at the higher 2.5-MHz speed. Because other locations (like the ones associated with peripheral card I/O) must always be written to and read from at 1 MHz, the speedup of Apple II software depends on the memory locations the software uses.

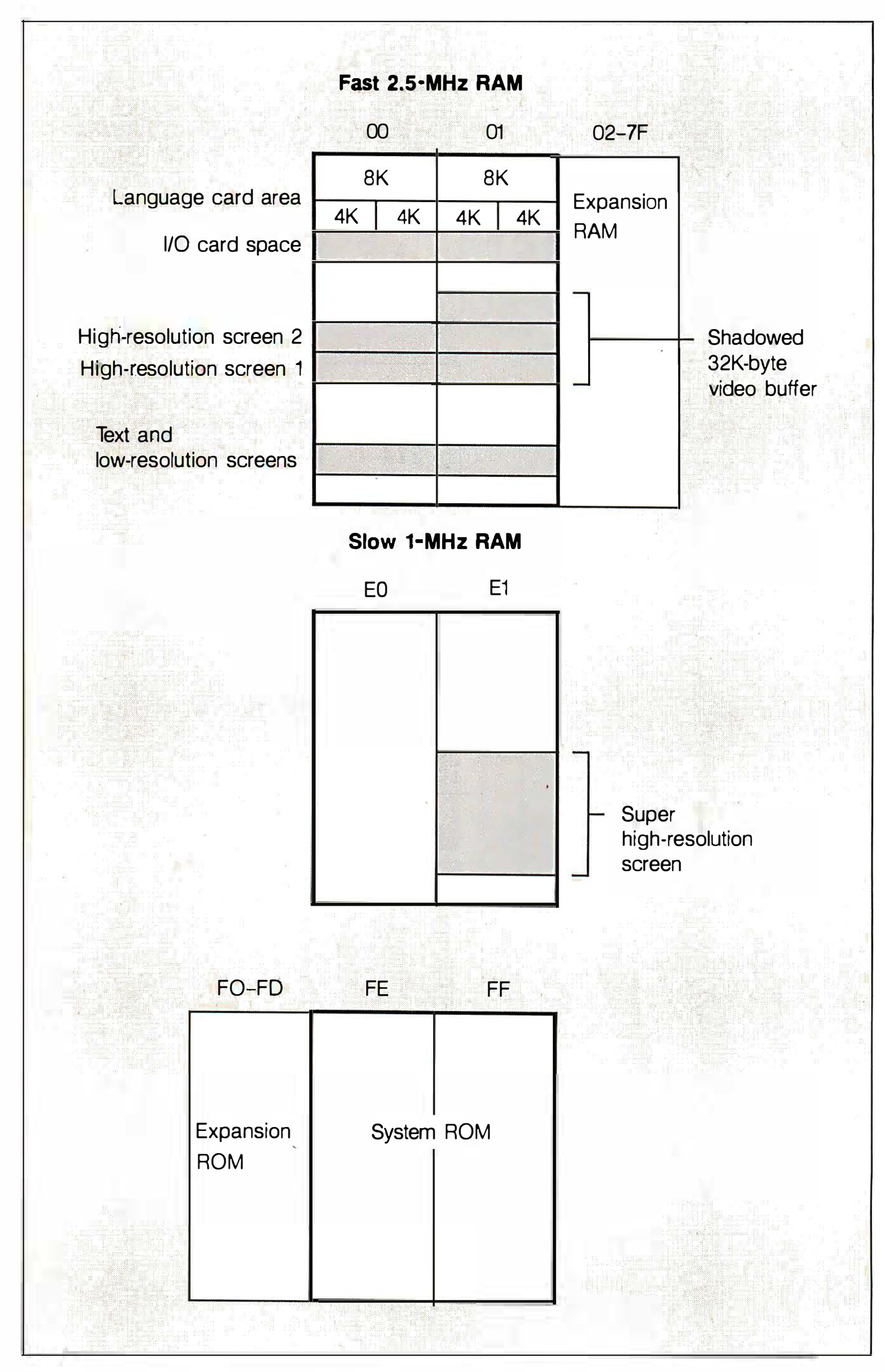


Figure 2: *The Apple II GS memory map. Shaded areas indicate shadowed memory, where any write operation is duplicated to the corresponding location in banks E0 and E1 hexadecimal. The super hi-res screen does not need shadowing, but it is included as a convenience to Applesoft and 6502 programmers, who can only work with banks 00 and 01. Memory areas are not drawn to scale.*

Note that this scheme gets two things done. First, it allows existing Apple II programs to write to bank 00 and 01 locations at the correct speed and have the associated hardware perform the expected interaction. Second, it allows programs to execute in the fast 2.5-MHz memory, slowing down only at specific times.

By default, the Apple II GS shadows text page 1 in both banks, hi-res pages 1 and 2 in bank 00, a 32K-byte area (2000–9FFF hexadecimal) in bank 01 used for the new super hi-res graphics modes, and the 4K-byte section of memory at CXXX hexadecimal in bank 00. However, programs can access a "shadow register" that can disable shadowing in individual areas. This speeds up program execution and allows the program to use the unshadowed areas and their E0/E1 (hexadecimal) counterparts for other things.

(The bit that shadows the CXXX [hexadecimal] area also uses the actual memory in locations C000–CFFF hexadecimal to hold the 4K-byte alternate language-card areas for both banks. When this shadowing is turned off, the language cards of banks 00 and 01 are no longer present, and the 65C816 sees a completely linear address space in banks 00 and 01. [However, all Apple system software requires the CXXX shadowing to be enabled.] The FPI chip controls shadowing and, in general, the intercepting and translating of all the address requests from the 65C816.)

Slots and Ports

The II GS's expansion slots are identical in function and configuration to the Apple IIe's slots with the exception of one added signal, /M2SEL, which appears at pin 39, replacing the 6502 SYNC signal. /M2SEL is an active-low signal that indicates when the II GS is executing at slow speed (1 MHz) and the address lines A0–A15 are valid (i.e., the II GS is talking to the slow RAM or I/O). In some ways, this signal is redundant with the old IOSEL and DEVSEL signals in the II+/IIe, and boards that use these signals should have no problem operating in an

Apple II GS. Control-signal generation and clock-signal buffering on the ports are handled by the SlotMaker custom IC.

Associated with each I/O expansion slot are built-in circuits and firmware that form an "invisible" port. The default settings for the seven slots are

Slot 1 serial printer port
Slot 2 serial modem port
Slot 3 80-column display
Slot 4 mouse
Slot 5 3½-inch disk drives
Slot 6 5¼-inch disk drives
Slot 7 AppleTalk

It is as though you had an Apple IIe with boards for all the above devices already plugged in. Unfortunately, this wealth of built-in interfaces carries with it some restrictions, the most severe being that if you have an expansion board you want to run in your II GS, you must give up the built-in port of whatever slot you plug the board into. (You use the Control Panel to choose whether a slot is using its associated default port or a plug-in board; this information is retained in battery-backup RAM.) The serial ports of the Apple II GS appear on the rear of the cabinet in the form of a pair of 8-pin mini-DIN connectors. They are pin- and signal-compatible with the serial connectors on the back of the Macintosh Plus—in fact, the USART in the II GS is the same as the Macintosh's: a Zilog 8530 serial communications chip. If you access the serial ports through the firmware, they "appear" identical to the Apple Super Serial Card (SSC), even though the SSC uses a different UART, a 6551. This has dire consequences for software that talks directly to the serial-port hardware on Apple IIs equipped with SSCs. Such software—and this includes practically all of the commercial communication packages—will certainly fail on the II GS.

Programs that bypassed the SSC's firmware did so to break the speed limitations of the firmware's non-interrupt-driven, unbuffered I/O routines, which were virtually useless for dependable communications at 1200 baud. The II GS's serial port firmware solves these troubles: It is interrupt-driven, and each serial port has input and output buffers that default to 2K bytes each but can be set to up to 64K bytes each.

The Apple II GS's built-in disk port is a 19-pin miniature D-type connector in the middle rear of the machine. You can daisy-chain up to four drives, up to two 3½-inch drives followed by up to two 5¼-inch drives. Owners of Apple IIs who might want to use their drives on the II GS can simply plug their Disk II controller into slot 5 or 6 and override the default setting for that slot.

MEMORY EXPANSION SLOT

The Apple II GS motherboard has a special memory-expansion slot designed for a card with up to 8 megabytes of RAM and 896K bytes of ROM (bringing the system's total ROM to 1 megabyte). The RAM maps into banks 02 to 7F hexadecimal, and the ROM maps into banks F0 to FD hexadecimal. It is easiest to design 1- and 4-megabyte RAM cards (using 256K-bit by 1 chips and 1 megabit by 1 chips, respectively), but the II GS engineers said that, with a few extra chips for interfacing, you could design an 8-megabyte RAM card; however, since the machine is not designed to hold user RAM above bank 7F hexadecimal, an 8-megabyte RAM card would be unable to access the top two banks (128K bytes) of its memory.

SMARTPORT

SmartPort is a set of assembly language routines (held in firmware) for accessing block and (as yet undesigned) character I/O devices on the Apple II GS. The SmartPort routines provide support for 3½-inch disk drives, a RAM memory disk (called the /RAM device), or a ROM memory disk (5½-inch drives, though part of the daisy chain, are controlled by the Disk II firmware, and future hard disks can be designed to respond to SmartPort routines without being part of the daisy chain).

SmartPort handles I/O in blocks of 512 bytes; since the routines permit up to a 4-byte block number, SmartPort can manage devices with storage capacities up to 2,199,023,255,552 bytes. SmartPort's basic functions include get device status, reset a device, format a device, read a block from a device, write a block, and send control information.

Any I/O expansion card that adheres to SmartPort conventions will have signature bytes at specific locations in its on-board ROM. The II GS's firmware will hunt for and recognize these at boot-up time, just as ProDOS currently does on the Apple II.

As its name implies, the ROM disk is the equivalent of a RAM disk emulator in nonvolatile read-only memory. This could come in handy for keeping frequently used programs like assemblers, compilers, or the like on hand for rapid execution. The II GS memory space has eight 64K-byte banks set aside for ROM disk expansion, located just beneath the firmware ROM in banks F0–F7 hexadecimal.

DESK ACCESSORIES AND THE CONTROL PANEL

You can think of a desk accessory as a mini-application that can be run from within another program. Macintosh owners are already familiar with desk accessories—those utility programs from the menu bar that appear when you click on the apple symbol. The II GS supports two types of desk accessories (with a tip of the hat, perhaps, to Coca-Cola): classic desk accessories (CDA) and new desk accessories (NDA). A classic desk accessory can be activated only by a keypress. Classic desk accessories can be run with older Apple II programs (such as Appleworks) and new II GS programs. A new desk accessory runs in the II GS's desktop environment and is available from a pull-down menu similar to the Macintosh's desk-accessory menu.

One classic desk accessory is built into the II GS: the Control Panel. You call up the Control Panel by simultaneously pressing open-apple-Control-Escape, which presents you with a menu containing the following system configuration options:

- Display selects color or monochrome monitor, display width, and colors for text, background, and border.

(continued)

• **Sound** displays two "slider switches" used to adjust the II GS speaker's pitch and volume.
• **Speed** selects 1.0-MHz or 2.8-MHz ("normal" or "fast") operation of the 65C816 CPU.
• **Clock** sets the II GS system clock time and date.
• **Options** alters parameters of the II GS's keyboard: keyboard layout, keyboard buffering on or off, repeat speed and delay, and others.
• **Slots** lets you indicate for each of the II GS's seven I/O slots whether the slot is running an "invisible" port or a plug-in board.

Other selections from the Control Panel let you set parameters for the serial ports and enable a RAM disk. You can use the Control Panel from within any program; we even used it in the middle of a disk access with no adverse effects.

VIDEO MODES AND THE VGC

Because the Apple II GS emulates the Apple II, it contains all the text and graphics modes of the Apple II: 24 by 40 text, 24 by 80 text, 48 by 40 low-resolution and 48 by 80 medium-resolution graphics with 16 predefined colors, 192 by 140 hi-res graphics with 6 predefined colors, and 192 by 140 double hi-res graphics with 16 predefined colors and 192 by 560 monochrome graphics. (Apple claims double the above numbers for hi-res resolutions in the horizontal directions, but the numbers here more accurately reflect the true nature of hi-res graphics because of the color limitations between adjacent pixels.)

As stated earlier, removing the banks E0 and E1 (hexadecimal) dynamic RAM refreshing from the video display circuitry makes new video modes possible. A new custom chip, the Video Graphics Controller (VGC), implements both old and new video modes as well as unrelated support functions for the built-in clock chip, the disk drives, the interrupt system, and built-in chip and board testing routines. The VGC enhances current text modes by allowing the user to choose from the Control Panel the color (or gray scale value) of the text, its background, and the border outside the active text/graphics area. These modes are available only when using an RGB color or monochrome monitor.

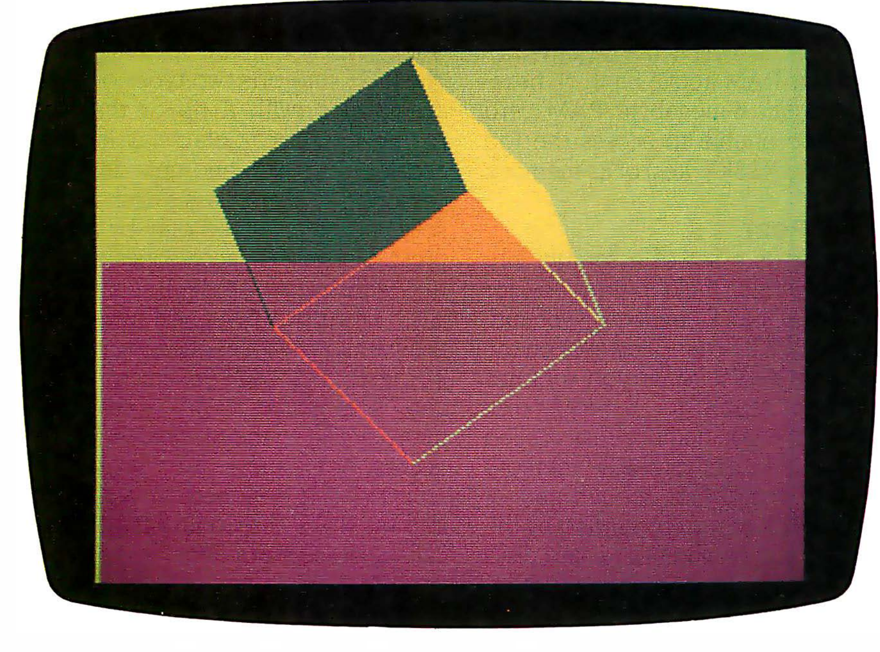


Photo 2: *Apple super hi-res graphics (200 by 320), fill mode, and line-addressable mode switching. The top (green) portion of this photo is in fill mode, while the bottom is not. Note that the colored outline of the cube determines what color a given face will be painted in fill mode. Note also the green line running down the left side the screen; this line makes the background color of the screen green. (Courtesy of Apple Computer.)*

SUPER HI-RES GRAPHICS

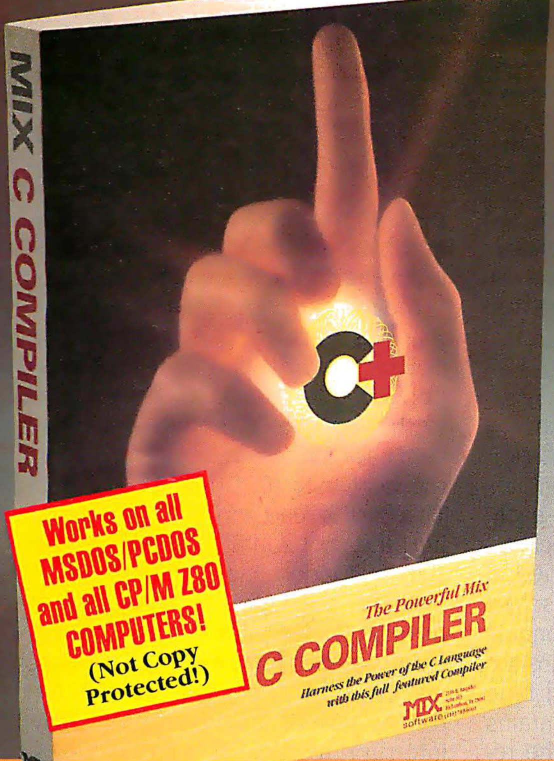
The new modes are called "super hi-res." Actually, there are three modes that can be used in four ways; two of them are pretty straightforward and useful, while the other two are more experimental.

Associated with the super hi-res modes is a 32K-byte chunk of memory in bank E1 ranging from addresses 2000 to 9FFF (assume that the addresses in this section are hexadecimal and the quantities are decimal). The pixel map occupies the range from 2000 to 9CFF, an important set of pointers occupies locations 9D00 through 9DFF, and color palette information fills the remainder of the area, from 9E00 to 9FFF. (To get into these modes, write C1 hexadecimal to location C029, and write 41 hexadecimal into it to restore the Apple II modes.)

The pixel map contains exactly 32,000 bytes arranged as 200 rows of 160 bytes each. Apple II programmers, who have always struggled with a convoluted pixel-to-memory mapping scheme, will be surprised by the fact that the super hi-res modes are completely linear, with a row-first stream of pixels corresponding to an unbroken, increasing progression of memory addresses. In other words, the first pixel on the first line uses the high bits of location 2000, while the same pixel in the second line uses location 20A0 (160 bytes later), and so on.

There are two super hi-res modes. Both have 200 lines per screen, but one has 320 pixels per line (see photo 2), while the other has 640 pixels per line. Since each line is represented by 160 bytes, each pixel has 4 bits of memory in the 320 mode and 2 bits in the 640 mode (see figure 3). This scheme gives you 16 colors in the 200 by 320 mode and 4 colors in the 200 by 640 mode, with no restrictions on the color of adjacent pixels (a prob-

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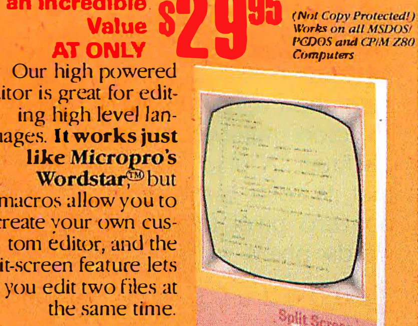
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lem that complicates the Apple II hi-res modes).

With the old Apple II hi-res modes, the electronic characteristics of both the Apple II and its video display determined the colors that were available; for example, the hi-res mode gave you the colors violet, blue, green, orange, black, and white. The Apple II GS, through the VGC chip, gives you more control over the colors in your graphic display. The super hi-res mode lets you choose your palette of 16 colors from a color set of 4096.

But which of these 16 colors are used in the 640 by 200, 4-color mode? The answer is all of them, the details of which lead us to one of the experimental super hi-res modes. The two bits of a pixel in this mode can have four values, so they are used in this mode to choose from 4 colors in the 16-color palette. Which 4 colors? Apple II programmers will recognize the answer as yet another convoluted video mode in the Apple II tradition: The 4 colors available for a pixel depend on its position within a byte (see figure 3b).

Palettes and Pointers

Actually, the Apple II GS defines a 512-byte area starting at location 9E00 hexadecimal; this area contains 16 color palettes of 32 bytes each, numbered from 0 to F hexadecimal. Each color in a palette is defined in 2 bytes, using 4 bits each to describe the red, green, and blue components of the color. The first byte contains the values for green (bits 7-4) and blue (bits 3-0); the second byte contains the red value (bits 3-0), with the remaining bits set to zeros.

Why are there 16 palettes? Because each scan line can use any of them in any order. This brings the total number of colors that can appear onscreen to 16 × 16 = 256 colors. Expect to see some uncharacteristic graphics as soon as programmers learn their way around the machine.

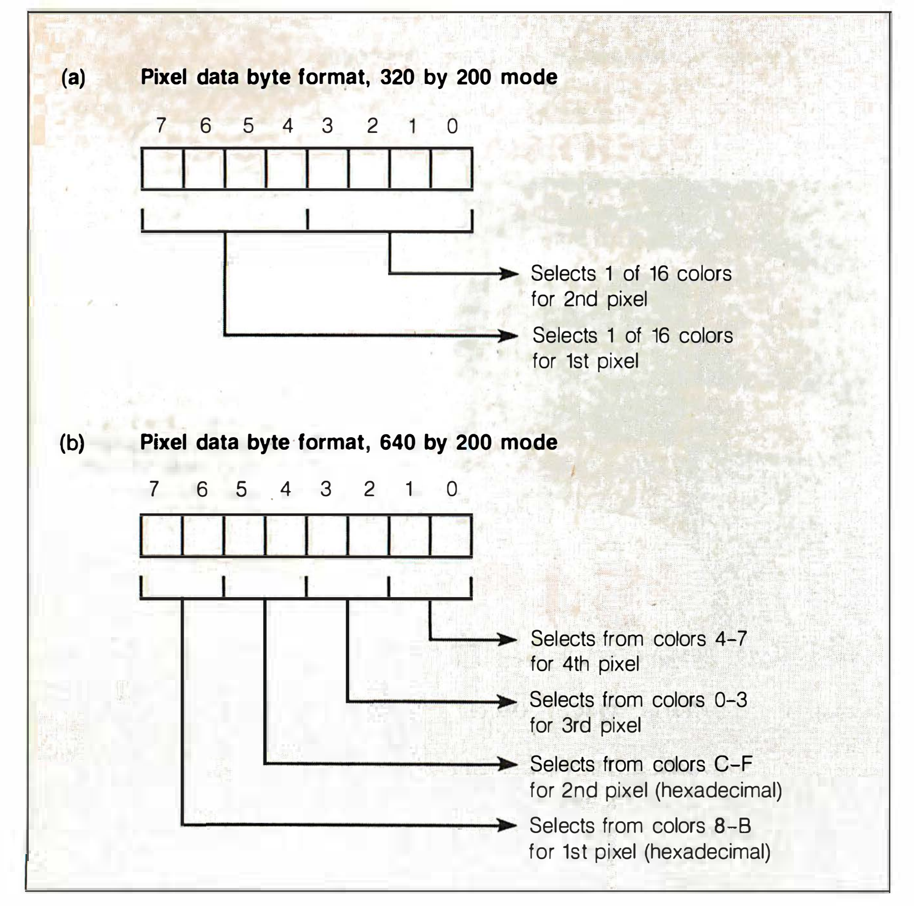


Figure 3: *(a) Pixel decoding in the 320 by 200 and (b) 640 by 200 super hi-res modes.*

The final surprise of the super hi-res graphics modes comes from the pointer area. The pointer byte at location 9D00 hexadecimal corresponds to the top line of the video display, with each successive scan line getting the next byte: 9D01, 9D02, . . . , etc. This byte is read and interpreted during the horizontal retrace of the previous video line.

Within each pointer byte, bits 3 through 0 determine which of the 16 color palettes is to be used. Bit 4 is not used and should be set to 0. Bit 6 does nothing if set to 0. If it and an interrupt register at address C023 hexadecimal are both set to 1, the VGC generates an interrupt at the beginning of the line; this will allow the advanced programmer to wring extra performance out of the super hi-res screen by altering palette values (or making other useful changes) "on the fly"—that is, while the machine is drawing the video display. Bit 7 determines the resolution: 0 for 320 pixels, 1 for 640.

This leaves bit 5, which does nothing if set to 0 but which activates the final, experimental super hi-res mode, called *fill mode* (see photo 2). In fill mode (which works in 200 by 320 resolution only), you have access to 15 colors (numbers 1 through F, hexadecimal). A pixel value of 0 means that its color is the same as the last nonzero pixel to the left. In other words, pixels with the values

3 0 0 0 2 0 0 0 0 0 0 0 0 9 0 0 0

would appear as colors

3 3 3 3 2 2 2 2 2 2 2 2 2 9 9 9 9

and you could change the large area painted with color 2 to, say, color 5 by changing one pixel (the fifth one) from a 2 to a 5. (Note that the first pixel in a line must always be nonzero.) This mode will be good for drawing large areas and changing their colors very quickly.

Sound

The heart of the II GS's sound system is the Digital Oscillator Chip manu-

(continued)

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factured by Ensoniq and used in the Mirage digital synthesizer. The DOC is attached to its own personal bank of 64K memory into which programs store wave tables that the DOC uses to generate sound. This memory is accessible only through special registers in the Sound General Logic Unit, a custom chip that acts as an interface between the DOC and its memory and thus allows sound generation to proceed independent of other processing in the Apple II GS. Additionally, registers within the Sound GLU chip regulate the gain of the II GS's audio amplifier, providing control of the speaker's volume.

The Ensoniq DOC contains 32 oscillators that the II GS firmware operates in pairs to generate a tone. Since one of the oscillators is used by the system to generate a time-slice interrupt for the DOC, the Apple II GS can produce up to 15 independent tones simultaneously.

A wave table is a series of bytes in the DOC's memory such that each byte represents the instantaneous value of the amplitude of the sound's output waveform. An oscillator on the DOC will step through this table fetching bytes and passing them to an on-chip digital-to-analog converter that produces the analog waveform that, after filtering, goes to the speaker. This technique allows generation of a theoretically limitless range of sounds, bounded only by the amount of memory available. The limit of 64K dedicated memory is no impediment, since the II GS allows you to fill one portion of a wave table while the DOC is fetching information out of another.

The II GS passes the unamplified monophonic signal of the sound system's output to a mini stereo phone jack on the back panel of the machine. This output is capable of driving a pair of Walkman-style headphones or, with the proper adapter cable, the input of a stereo amplifier. The designers of the II GS have also provided a connector on the motherboard that gives direct access to several useful DOC signals, including an unfiltered audio output, channel selection logic signals (can be used to implement eight independent audio channels), and an input to the DOC's analog-to-digital converter (for a sound sampler/digitizer).

The Apple II GS Toolbox

In the past, the Apple II could be almost completely described by its hardware features. The Apple II GS ends this tradition with its inclusion of significant amounts of system software in both ROM and RAM meant to be available to all programs. It is not accidental that these routines are similar in name and function to those in the Macintosh computer. The Mac toolbox is an elegant, powerful system proven to work and improved by two years of intensive use.

The Apple II GS toolbox implements the most useful Macintosh toolbox functions, though sometimes it does so in a different way; the Memory Manager, for instance, works quite differently from its Macintosh counterpart because of the way the Apple II GS's memory is divided into 64K-byte banks. However, the Apple II GS doesn't duplicate all of the Macintosh toolbox.

The code in the Apple II GS toolbox is divided into *tool sets*, and the individual routines are called *tool calls*. The tool sets that are in ROM are the Tool Locator, Memory Manager, SANE (Standard Apple Numerics Environment) Numerics, Desk Accessory Manager, Event Manager, Sound Manager, Integer Math Tools, Text Screen Tools, Scheduler, and Miscellaneous Tools. QuickDraw II is divided between ROM and RAM.

The remaining tool sets are stored on disk and loaded into RAM by the application that needs them. Once in memory, they are indistinguishable from tools stored in ROM. They are the Menu Manager, Window Manager, Control Manager, Line Editor, Dialog Manager, Scrap Manager, and Print Manager.

Tool Set Structure

The Apple II GS tool set has no fixed routine entry points and only four fixed addresses associated with its toolkits, yet any program can execute any toolbox routine in RAM or ROM, even if a routine is changed or moved to a different location after the program is written. Both tool sets and tool calls are numbered (starting with 1), and any tool call can be executed by the following assembly language sequence:

```
push  inp1
ldx   #CallID
jsl   Dispatch
```

This pushes any input onto the stack, loads the 16-bit X register with a call ID constant that has the tool call number in the high byte and the tool set number in the low byte, and does a subroutine jump to a fixed entry point. A high-level language would compile a normal procedure call as a series of 0 or more push instructions, followed by a jump to a different location that performs the above function while handling an extra 3-byte return value on the stack. The Apple II GS designers estimate that this type of call has an overhead of about 118 microseconds. Parameters can be passed in several ways, based on the needs of the individual routine: on the stack, in a known block of memory, or in the A, X, and Y registers.

To increase the usability and extensibility of the II GS, its designers provided an identical but parallel structure that allows programmers to build and use their own tool sets without "borrowing" tool set numbers that Apple may later use. The only difference between the two is a different entry point, "UDispatch" instead of "Dispatch."

Toolkit Memory Usage

Many tool calls need their own memory—sometimes page zero locations to speed up their execution, sometimes other memory for passing parameters or sharing or storing data. The Apple II GS designers resolved the conflicting memory needs of many different tool calls by regulating memory usage as follows: The program using the tool sets will itself allocate page zero memory, and tool sets will allocate the other memory they need by asking for it through the Memory Manager. They can then point to it with the WAPT (Work Area Pointer Table) entry reserved for that tool set, and their tool calls will always

(continued)

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QUICKDRAW II

QuickDraw II deserves mention because of its importance for desktop-based Apple II GS software. It is a tool set, partly in ROM and partly in RAM, that provides a standard set of useful graphics routines for drawing window/menu-oriented screens. Wherever possible and appropriate, it attempts to work equivalently to a subset of Macintosh QuickDraw routines. The pre-release documentation lists 146 QuickDraw II tool calls, of which 114 are listed as being the same as their Macintosh equivalents, 22 are listed as being similar, and 10 are entirely different or absent. The degree of consistency between QuickDraw and QuickDraw II will be very important to Macintosh software developers attempting to convert their software to the Apple II GS.

PRODOS

Apple has crowned ProDOS *the* operating system for the Apple II series of computers, and the company will be guiding ProDOS along a carefully controlled development path that proceeds as follows:

- ProDOS 1.1.1 will continue to be supported for the Apple IIe and IIc computers and many ProDOS 1.1.1 programs will run on the II GS.
- ProDOS 8, an altered version of ProDOS 1.1.1, will become the standard 8-bit operating system for the Apple II. It will work on the IIe, IIc, and II GS.
- ProDOS 16 will be the 16-bit operating system used for Apple II GS software. Version 1.0, supplied with the machine at its introduction, is built on a ProDOS 16 framework but is implemented by a ProDOS 8 core surrounded by a shell handling ProDOS 16–style calls. ProDOS 16 version 2.0 will be released in the first quarter of 1987.

THE FINDER

We did not see the Finder working when we saw the Apple II GS, but its preliminary documentation describes it as "a combination Program Selector/Disk Utility for managing documents and directing traffic between the user and storage devices." It seems to be a pretty faithful imitation of the Macintosh desktop interface, with several exceptions.

First, the "Special" menu has two new items—"Check Drives" and "Format." The first causes the Finder to update its knowledge of what disk is in each drive (remember that, in an Apple II system, you can change the floppy disk in a drive without the computer knowing what you've done). The second will eventually allow you to format a disk in either ProDOS, Apple Pascal, DOS 3.3, or Apple CP/M formats; the initial release, however, will only format disks for ProDOS.

Second, the Finder will interact most fully with ProDOS disks and programs. Since only the ProDOS operating system has subdirectories, only ProDOS disks will have folders in their windows. When you exit a ProDOS program, it will return you to the Finder.

Third, the Finder does not support custom file icons. Each icon will have a shape determined by its file type.

Finally, the Finder will support rudimentary printing of text files.

A future version of the Finder will probably add the Macintosh MFS (old) and HFS (hierarchical) disk formats, Apple Pascal 1.3, and Apple CP/M to the file types supported.

APPLE DESKTOP BUS

The Apple Desktop Bus (ADB) is used for the generalized connection of the computer with up to 16 input devices daisy-chained to a single connector on the back panel; it currently supports multiple keyboards (for educational and other programs) and a mouse (ending the daisy chain), but the design can accommodate other kinds of devices. Devices are connected through a shielded 3-conductor cable using mini-DIN-4 connectors.

The ADB is controlled by a dedicated 8-bit processor called the ADB microcontroller (abbreviated here as ADBM); in addition, the mouse and keyboard are controlled by custom microcontrollers that interact with the ADBM. The ADBM and the intelligent devices "talk" on a bus where only the ADBM can issue commands; the devices reply as appropriate with data or requests for service.

In general, the ADBM handles low-level interaction with the keyboard, mouse, and other input devices, thus freeing the 65C816 processor from having to handle such tasks.

APPLETALK

Unlike any other Apple Computer product, the Apple II GS includes built-in AppleTalk code in RAM and ROM. Through the Control Panel, you can configure slot 7 as AppleTalk; the II GS then uses one of the two serial ports as its AppleTalk port.

The II GS implements the bottom two (of seven) levels of AppleTalk protocol: Link Access Protocol (LAP) and Datagram Delivery Protocol (DDP). It also implements enough of the next

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EXTENDED APPLE II GS COVERAGE ON BIX

BYTE magazine has a lead time of several months, but the lead time on BIX (BYTE Information Exchange) is measured by how fast we can type. By the time you read this, we will have active a special "Apple II GS event" on BIX that will include further technical details, exact prices, BIX users giving their impressions of the machine as it comes out of the box, and more. Much of this information will be excerpted in the Best of BIX section of BYTE as soon as our lead time allows.

For more details about the special Apple II GS coverage in BIX, log on to BIX, type join apple, and then join the first topic with 'GS' somewhere in its name.

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two levels, Name Binding Protocol (NBP) and AppleTalk Transaction Protocol (ATP), to boot the II GS from a remote file server (thus allowing it to be used in a network environment without its own disk drive).

PRICING

The price for the Apple II GS had not been set at the time of this writing, but we expect the price for a starter system with one 3½-inch disk drive and a monochrome monitor to be in the $1400 to $1600 range.

COMPATIBILITY

For many users, especially current owners, software and hardware compatibility will be the make-or-break factor in their decision to buy an Apple II GS. The II GS engineers did an incredible job of designing a new, more powerful computer that is largely compatible with the existing body of Apple II hardware and software. One engineer estimated the II GS's hardware compatibility at "about 80 percent" and its software compatibility at "95 to 99 percent."

Complete software compatibility is impossible, largely because of the completely unregulated way the Apple II has been programmed in the last 10 years. People wrote code that jumped into the middle of ROM routines, used machine language op codes that were unimplemented in the 6502 (but that are in the 65C816), and implemented countless copy-protection schemes, many of which depended on particular hardware details that were replaced in later Apple II designs.

The final verdict must wait until we get to test a production-line machine, but we tested several Apple II game and business programs and found two that fail trying to execute formerly unimplemented op codes (THE Spreadsheet and Serpentine) and one (HomeWord running under ProDOS 1.1.1) that doesn't work because the 65C816 does not completely emulate the way the 6502 wraps an X-register address from FFFF hexadecimal to 0000 (it wraps to 10000 hexadecimal).

Most peripheral cards that do not implement "phantom slots" (where a multifunction card appears to be several cards in different slots) will work, but some cards won't; we were told, for example, that the Mountain Computer Music Card set won't work because of the way it uses interrupts.

As with previous enhancements to the Apple II line, such differences cause problems for the first year or so, then they fade from consciousness as companies revise their products and users find patches or workaround measures for products that don't work. In general, the more recent your Apple II software or hardware, the more likely it is to run properly.

CAVEATS

We wrote this product preview in July 1986, after two days with the Apple II GS engineering staff, much study of seven volumes of developers' technical documentation, and subsequent telephone conversations with the engineers. When we saw the Apple II GS, the firmware was about to be "frozen," and the machine itself was in "final preproduction"; only minor changes are likely to be made at this point. We did not get to see the Finder software, but we had several hours of hands-on experience and ran several impressive sound and graphics demos.

(We wish to thank Rob Moore, Harvey Lehtman, and many other Apple people for their help.)

CONCLUSIONS

What do you say about such innovative energy that has been directed primarily toward preserving a hardware design that is 10 years old? The Apple II GS designers' achievements are remarkable, but the burden of the classic Apple II architecture, now as venerable (and outdated) as COBOL and batch processing, may have weighted them down and denied them any technological leaps beyond an exercise in miniaturization. Also, the 65C816 may prove to be an IC of mixed blessings: While it does provide a means of supporting the 6502 within a processor that also operates in a 16-bit mode, to programmers it represents yet another instruction set that has to be learned and whose oddities will have to be dealt with.

The Apple II GS affirms several trends in microcomputer design that we should not ignore: improved graphics and sound, larger processor and memory capacity, and the use of a mouse and a desktop/icon/windows user interface. The machine also follows a trend but breaks new ground in the Apple II line by including large amounts of system firmware that is as important as the machine's new hardware features.

Because Apple perceives itself as a "premium label," its pricing will not be as aggressive as many users would like it to be. Apple is becoming—dare we say it?—more and more like IBM, selling more on name, reputation, and installed base of software and hardware (not a strong selling point, in the case of Apple II software) than on computing-power-per-dollar value.

The Apple II GS, hog-tied by Apple II compatibility, approaches but does not match or exceed current microcomputer capabilities. The 8086-like segmented memory of the 65C816 is not as elegant as that of the 68000, used in the Apple Macintosh, the Commodore Amiga, and the Atari 520ST. In addition, the 65C816 lacks the hardware multiply and divide instructions available in both the 8086 and the 68000 processors. The Apple II GS's graphics, though now competitive, do not offer any advantages over the Amiga's or the Atari ST's, nor is its price competitive with either. Its only clear superiority is in its sound capabilities, which for many buyers will not outweigh graphics and price.

Ironically, the Apple II GS will suffer from the traditional lack of software and hardware upon its introduction. Vendors will take longer than they expect to come out with new products, and many will enhance existing products for the Apple II instead of writing new software that fully exploits (and is limited to) the Apple II GS. Granted, a tremendous amount of software is already out there, but the Apple IIe and IIc will run it with fewer compatibility problems and at a significantly lower cost. As with new machines before it, people will buy the Apple II GS because they see the unrealized promise of its new features. ■

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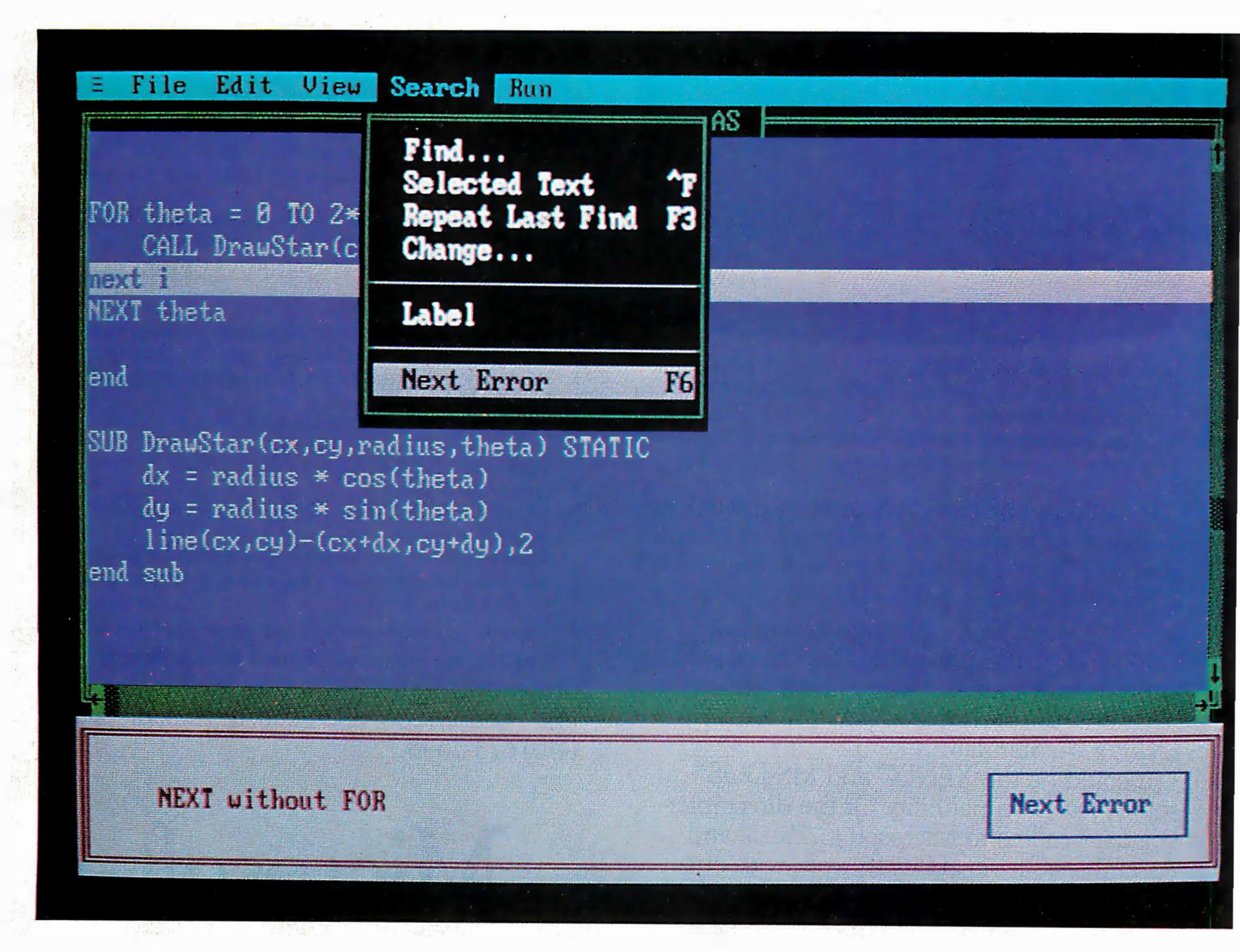
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Seconds per iteration	78	0.52

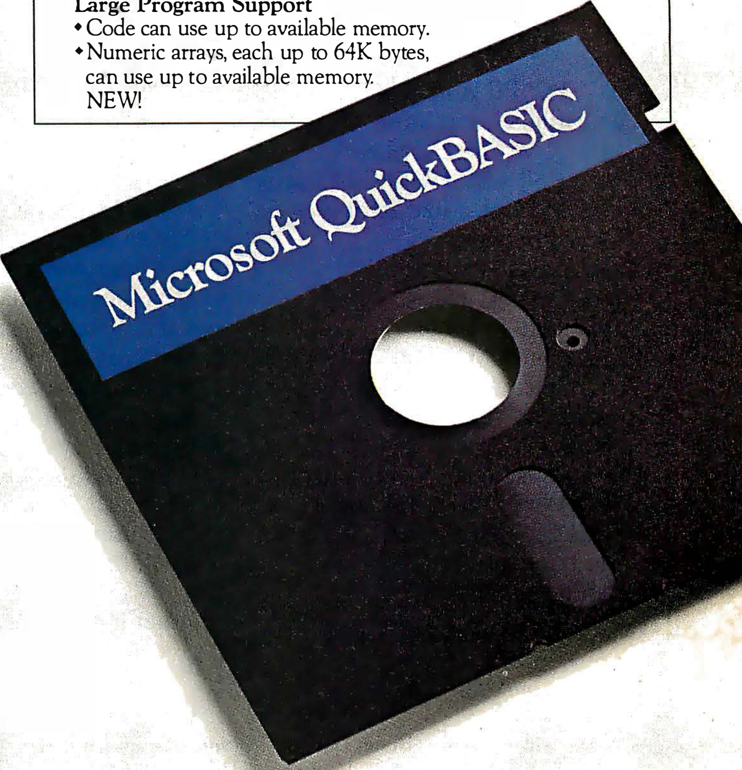
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BUILD AN INTELLIGENT SERIAL EPROM PROGRAMMER

BY STEVE CIARCIA

Steve's new and improved device includes on-board CPU and intelligent firmware



I don't like admitting that I made a mistake, but apparently I did. Well, not actually. You see, I was dragged into . . . Let me start from the beginning.

My February 1985 Circuit Cellar article was a project on how to build a serial EPROM programmer, about which I said: "The latest Circuit Cellar EPROM programmer is a serial-port programmer that has the speed of a turtle, the intelligence of the mightiest computer (that is, *it* has absolutely no smarts of its own), and is as functional as a doorstop between uses. On the positive side, it's fully documented, universally applicable, and easily expandable to accommodate future EPROM types."

What a mess after it was published! Everybody must have built this programmer. BYTEnet almost shut down the Peterborough phone company as people downloaded the BASIC listings, and my staff developed "postage tongue" replying to the correspondence. Needless to say, the project was well received.

In truth, it was an experimenter's project intended to satisfy a certain core of supporters yet enlighten the larger audience of readers about EPROM programming in general. Because I could not gauge its potential reception, and also because I didn't see it as having any greater performance than low-cost bus-compatible programmer boards, I didn't arrange to have it made into a printed circuit board as are most of my projects. I'm embarrassed to say that even after all these years I underestimated the number of experimenters who wanted to build a serial EPROM programmer.

It's too late to go back now, but I have to make up for past indiscretion and find some way to save face. I know that there are warmed soldering irons all across the country waiting for me to apologize appropriately. I trust you'll accept this improved rendition on an old theme as proper recompense.

As the title indicates, this programmer is still intended for serial-port operation. Thus, it retains computer and bus independence. The primary difference between then and now, however, is the addition of a microprocessor that greatly enhances its functions. The new Circuit Cellar intelligent serial EPROM programmer (CCSP for short) programs more types of EPROMs faster and

(continued)

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more reliably. It also functions as a stand-alone programmer for copying or verifying EPROMs. (See photo 1.) The following is a list of CCSP features:

- RS-232–compatible (no handshaking necessary)
- internal V_{pp} power generation
- menu-selectable EPROM types (no programming configuration jumpers)
- default power-up selectable data rates
- automatic power-down of EPROM for installation/removal
- stand-alone or computer system/terminal–connected operation
- menu-driven operation
- single-byte or full-buffer write modes
- 32K-byte on-board memory buffer
- read, copy, or verify EPROM
- Intel hexadecimal file upload/download
- verify after write
- verify EPROM erasure
- screen dump by page or byte
- BASIC driver that can be modified by the user
- program EPROMs in standard 50-millisecond and 1-ms fast algorithm modes
- support V_{pp} settings of 25, 21, and 12.5 volts
- program all 27xxx 5-V single-supply EPROMs, including 2716, 2732, 2732A, 2764, 2764A, 27C64, 27128, 27128A, 27C128, 27256, 27512, and any functional equivalents

Obviously, a list this impressive would take a great deal of effort to put together as a single month's project. The potential software development nightmares of assembly language serial drivers, menu displays, and table manipulations hardly made it worth adding a microprocessor to my original BASIC-language-manipulated unit. Besides, how could it be done in one month?

BASIC allowed a significant level of interactive menus and help displays while requiring little software overhead. Unfortunately, using a high-level-language interpreter to simplify software development is of little value when the primary goal of producing a better programmer requires fast data manipulations that are best accomplished in assembly language.

Rather than be thwarted by this apparent dilemma, I decided to design a hybrid system that used both BASIC and assembly language. The obvious choice was the BASIC-52 computer/controller I presented in the August 1985 project. With the help of software guru and friend Bill Curlew, the CCSP was designed, built, and tested in two weeks flat.

The CCSP uses an Intel 8052AH-BASIC microprocessor that contains an 8K-byte ROM-based BASIC interpreter. Besides manipulating strings, tables, and menus, the BASIC contains serial communication drivers and easily links to assembly language routines. It seemed the perfect engine for a quickly designed user-modifiable project.

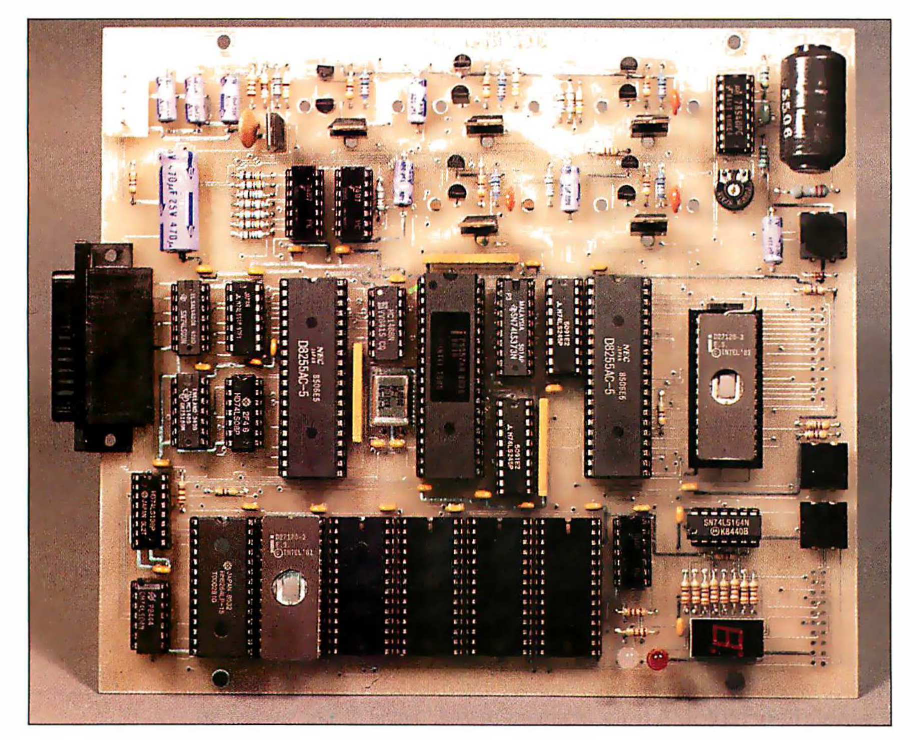


Photo 1: *Finished printed circuit prototype of the serial* EPROM *programmer. The digital section and memory buffer are at the bottom center. The analog-voltage-level switching section is at the top center.*

A Hybrid Approach

The CCSP is a stand-alone microcomputer with an application-specific I/O configuration. It supports 40K bytes of operating system and buffer RAM and 16K bytes of program ROM. It uses six parallel I/O ports to drive the programming-pin level-shifter voltage-control circuitry, EPROM address and data lines, and user-interactive buttons and display. The CCSP can be used by itself to copy EPROMs or, when connected to a terminal or computer, as a full-function programmer/verifier. It requires no programming jumpers or personality modules and is completely automatic. It programs/examines/verifies all 5-V EPROMs from 2716s through 27512s in both standard and fast modes (on applicable devices).

In the sections that follow, I'll describe the configuration of the microcomputer and its unique I/O structure. Once you have the hardware in hand, I'll describe the system software and how the different modes operate. First, I'll go over some EPROM basics.

A Review

A personal computer, even in its minimum configuration, always contains some user-programmable memory, or RAM, usually in the form of semiconductor-memory integrated circuits. This memory can contain

both programs and data. Any machine-word-level storage element within the memory can be individually read or modified (written) as needed.

Any of several kinds of electronic components can function as bit-storage elements in this kind of memory. TTL-type 7474 flip-flops, bistable relays, or tiny ferrite toroids (memory cores) are suitable, but they all cost too much, are hard to use, and have other disadvantages.

In personal computer and other microprocessor-based applications, the most cost-effective memory is made from MOS integrated circuits. Unfortunately, data stored in these semiconductor RAMs is volatile. When the power is turned off, the data is lost. Many ways of dealing with this problem have been devised, with essential programs and data usually stored in some nonvolatile medium.

In most computer systems, some data or programs are stored in ROM. A semiconductor ROM can be randomly accessed for reading in the same manner as the volatile memory, but the data in the ROM is permanent. The data in a mask-programmed ROM is determined during the manufacturing process. Whenever power is supplied to the ROM, this permanent data (or program) is available. In small computer systems, ROM is chiefly used to contain operating systems and/or BASIC interpreters—programs that don't need to be changed.

Another type of ROM is the PROM, which is delivered from the factory containing no data. The user decides what data to put in it and permanently programs it with a special device. Once programmed, PROMs exhibit the characteristics of mask-programmed ROMs. You might label such PROMs "write-once" memories.

The ultraviolet-light erasable EPROM is a compromise between the "write-once" kind of PROM and volatile memory. You can think of the EPROM as a "read-mostly" memory, used in read-only mode most of the time but occasionally erased and reprogrammed as necessary. The EPROM is erased by exposing the silicon chip to ultraviolet light at a wavelength of 2537 angstroms. Conveniently, most EPROM chips are packaged in an enclosure with a transparent quartz window.

How an EPROM Works

EPROMs from several manufacturers store data bits in cells formed from stored-charge FAMOS (floating-gate avalanche-injection metal-oxide semiconductor) transistors. Such transistors are similar to positive-channel silicon-gate field-effect transistors, but with two gates. The lower or floating gate is completely surrounded by an insulating layer of silicon dioxide, and the upper control or select gate is connected to external circuitry.

The amount of electric charge stored on the floating gate determines whether the bit cell contains a 1 or a 0. Charged cells are read as 0s; uncharged cells are read as 1s. When the EPROM chip comes from the factory, all bit locations are cleared of charge and are read as logic 1s; each byte contains hexadecimal FF.

When a given bit cell is to be burned from a 1 to a 0, a current is passed through the transistor's channel from the source to the gate. (The electrons, of course, move the opposite way.) At the same time, a relatively high-voltage potential is placed on the transistor's upper select gate, creating a strong electric field within the layers of semiconductor material. (This is the function of the +12.5-V, +21-V, or +25-V V_{pp} charging potential applied to the EPROM.) In the presence of this strong electric field, some of the electrons passing through the source-drain channel gain enough energy to tunnel through the insulating layer that normally isolates the floating gate. As the tunneling electrons accumulate on the floating gate, it takes on a negative charge, which makes the cell contain a 0.

When data is to be erased from the chip, it is exposed to ultraviolet light, which contains photons of relatively high energy. The incident photons excite the electrons on the floating gate to sufficiently high-energy states that they can tunnel back through the insulating layer, removing the charge from the gate and returning the cell to a state of 1.

When data is to be erased from the chip, it is exposed to ultraviolet light.

The 27xxx EPROMs contain bit-storage cells configured as individually addressable bytes. This organization is often called "2K by 8" for a 2716 or "8K by 8" for a 2764. The completely static operation of the device requires no clock signals. The primary operating modes include read, standby, and program (program-inhibit and program-verify modes are important primarily in high-volume applications).

Control inputs are used to select the chip and configure it for one of these operating modes. In the program mode, particular bit cells are induced to contain 0 values. Both 1s and 0s are in the data word presented on the data lines, but only a 0 causes action to take place. For example, the 27128 is in the programming mode when V_{pp} input is at 21 V and CE and PGM are both at TTL low. The data to be programmed is applied 8 bits in parallel to the data output pins. For regular programming, CE should be kept TTL low at all times while V_{pp} is kept at 21 V. When the address and data are stable, a 50-ms (55 ms maximum) active-low TTL program pulse is applied to the $\overline{PGM}$ input. A program pulse must be applied at each address location to be programmed.

Standard vs. Fast

In the old days, all we had to contend with were 50-ms timing pulses (neglecting obsolete 1702 and 2708 EPROMs). Today, the newest EPROMs can use a fast closed-loop programming algorithm that lessens programming time (realize that a 27512 takes about 1 hour to program in 50-ms increments). The CCSP supports fast programming.

(continued)

The fast algorithm uses closed-loop margin checking. To ensure reliable program margin, the fast algorithm utilizes two different pulse types: initial and overprogram. The duration of the initial PGM pulse(s) is 1 ms, which will then be followed by a longer overprogram pulse of length 4*x* ms; some chip types use 3*x* (*x* is the number of initial 1-ms pulses applied to a particular location before a correct verify occurs). Once it is verified, four times that number of pulses are applied to the same location to permanently burn the data. If 15 (some chip types require 25 pulses) 1-ms pulses are applied to any single-byte location without reaching the margin, the overprogram pulse is applied automatically.

The entire sequence of program pulses and byte verifications is performed at V_{cc} = 6.0 V and V_{pp} = 21.0 V (V_{pp} may be 12.5 V on some EPROMs). When the fast programming cycle has been completed, all bytes should be compared to the original data with $V_{cc} = V_{pp}$ = 5.0 V.

The fast algorithm may be the preferred programming method since it allows certain EPROMs to be programmed in significantly less time than the standard 50-ms-per-byte programming routine. Typical programming times for 27128s, for example, are on the order of 2 minutes, a sixfold reduction in programming time from the standard method.

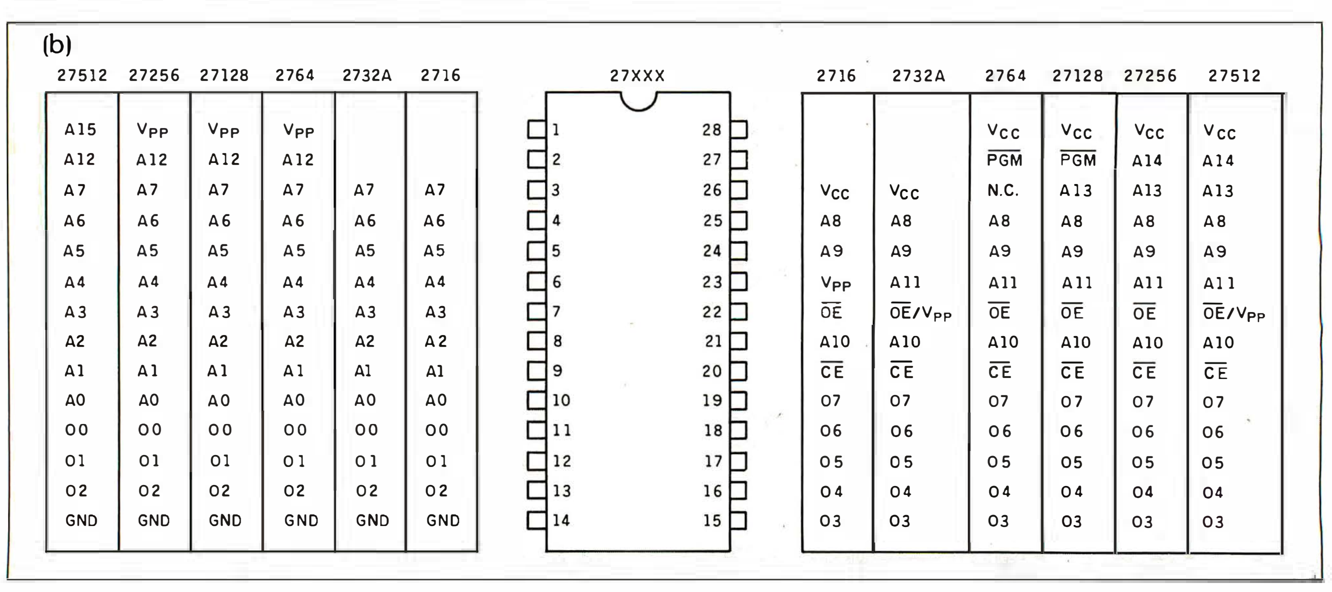
CONFIGURATION MAZE

The first problem encountered in any EPROM programmer design is to compare the pins of the various EPROMs (see figure 1b). Among the 28 defined pins (four are unused on 24-pin devices), 21 are used for the same functions (address and data). Evidently, semiconductor manufacturers never thought very far ahead or talked to each other, because the remaining seven pins are a complicated switching maze. Among the different EPROMs, the same pin location can

(a)

PIN #	2716	2732	2764	27128	27256	27512
1	N/C	N/C	VPP 21V 12.5V 5V	VPP 21V 12.5V 5V	VPP 12.5V 5V	A15 5V 0V
28	N/C	N/C	Vcc* 6V 5V	Vcc* 6V 5V	Vcc* 6V 5V	Vcc* 6V 5V
27	N/C	N/C	$\overline{PGM}$ 5V 0V	$\overline{PGM}$ 5V 0V	A14 5V 0V	A14 5V 0V
26/24	Vcc 5V	Vcc 5V	N/C	A13 5V 0V	A13 5V 0V	A13 5V 0V
23/21	VPP 25V 5V	A11 5V 0V	A11 5V 0V	A11 5V 0V	A11 5V 0V	A11 5V 0V
22/20	$\overline{OE}$ 5V 0V	$\overline{OE}$/VPP 25V 21V 0V	$\overline{OE}$ 5V 0V	$\overline{OE}$ 5V 0V	$\overline{OE}$ 5V 0V	$\overline{OE}$/VPP 12.5V 0V
20/18	$\overline{CE}$ 5V 0V	$\overline{CE}$ 5V 0V	$\overline{CE}$ 5V 0V	$\overline{CE}$ 5V 0V	$\overline{CE}$ 5V 0V	$\overline{CE}$ 5V 0V

*6.0 VOLTS ONLY ON EPROMS THAT ALLOW FAST PROGRAMMING


(b)

27512	27256	27128	2764	2732A	2716	27XXX pin	27XXX pin	2716	2732A	2764	27128	27256	27512
A15	VPP	VPP	VPP			1	28			Vcc	Vcc	Vcc	Vcc
A12	A12	A12	A12			2	27			$\overline{PGM}$	$\overline{PGM}$	A14	A14
A7	A7	A7	A7	A7	A7	3	26	Vcc	Vcc	N.C.	A13	A13	A13
A6	A6	A6	A6	A6	A6	4	25	A8	A8	A8	A8	A8	A8
A5	A5	A5	A5	A5	A5	5	24	A9	A9	A9	A9	A9	A9
A4	A4	A4	A4	A4	A4	6	23	VPP	A11	A11	A11	A11	A11
A3	A3	A3	A3	A3	A3	7	22	$\overline{OE}$	$\overline{OE}$/VPP	$\overline{OE}$	$\overline{OE}$	$\overline{OE}$	$\overline{OE}$/VPP
A2	A2	A2	A2	A2	A2	8	21	A10	A10	A10	A10	A10	A10
A1	A1	A1	A1	A1	A1	9	20	$\overline{CE}$	$\overline{CE}$	$\overline{CE}$	$\overline{CE}$	$\overline{CE}$	$\overline{CE}$
A0	A0	A0	A0	A0	A0	10	19	O7	O7	O7	O7	O7	O7
O0	O0	O0	O0	O0	O0	11	18	O6	O6	O6	O6	O6	O6
O1	O1	O1	O1	O1	O1	12	17	O5	O5	O5	O5	O5	O5
O2	O2	O2	O2	O2	O2	13	16	O4	O4	O4	O4	O4	O4
GND	GND	GND	GND	GND	GND	14	15	O3	O3	O3	O3	O3	O3

Figure 1: *(a) EPROM programming-pin functions by EPROM type. (b) The great EPROM pin-out maze, illustrating the configuration of those EPROMs the CCSP is designed to handle.*

supply power, address, or programming pulses. Figure 1a illustrates the differences in detail.

In inexpensive programmers, configuration jumpers are frequently used to select the specific wiring configuration for different EPROM types. Wire jumpers rather than semiconductor switches are used because of the high currents involved. Take pin 26 (pin 24 on 24-pin EPROMs) with either a 2732 or 27128 installed, for example. In both cases, the voltage level is 5 V. On a 27128 it is a TTL A13 address line; on a 2732 it is a 150-milliampere V_{cc} power line. Similarly, pin 22 (all pin numbers are referenced to a 28-pin layout) has to be set at 0 V, 5 V, 12.5 V, 21 V, or 25 V at currents ranging from 400 microamperes to 50 mA, depending upon the EPROM.

Fortunately, only five of the seven configuration pins require elaborate voltage and current control. Rather than use mechanical jumpers, I designed a voltage-control circuit that could be preset to the voltage limits of the desired EPROM type and easily pass high current when required. Figure 2 illustrates this basic circuit that is duplicated for each of the five pins (pins 28, 26, 1, 22, and 23).

The level shifter uses an LM317 voltage regulator as a programmable voltage controller. The basic LM317 output voltage is set by two resistors: R1 between the adjustment pin and ground and R2 between the adjustment pin and the output. As the formula shows, with R1=665 ohms and R2=221 ohms, the output is 5.0 V.

In this configuration, various R1 resistors can be connected from the adjustment pin to ground through open-collector 7407 drivers. These were used since they operate at up to 30 V (don't substitute a 7417). The four drivers from top to bottom set 5 V, 12.5 V, 21 V, and 25 V, respectively (not all sections are required for each EPROM pin). Their inputs are fed by a parallel output port.

Normally, the regulated output of an LM317 is 1.2 V to 32 V. An additional two-transistor control circuit is added to allow the output to go to 0 V on command. Rather than providing a resistance path to ground, however, this is accomplished by applying a negative 1.2 V to the adjustment pin. Because there is no way to know how many of the control circuits will be set to 0 V at any one time or if the 7407 drivers are enabled concurrently, the −1.4-V bias source is itself a regulated supply.

The CCSP level-shifter circuit can simulate a variety of programmable conditions. For example, by setting the 7407 driver that limits the output to 5 V and pulsing the 0-V enable line, we have a TTL-level $\overline{\text{PGM}}$, $\overline{\text{OE}}$, or $\overline{\text{CE}}$ control line. (In the tests I conducted, the circuit easily responded to control input changes of 20 kilohertz with little overshoot on the output. At those speeds, however, the output filter capacitor should be small.) Since the circuit is also capable of supplying 500 mA at 5 V, it is also appropriate to use this same circuit to supply and control V_{cc}.

The heart of the CCSP is found in the analog switching system and the management of the seven control lines in figure 1a. While I haven't explained yet how these level shifters are individually controlled, it still seems appropriate to show how they are ultimately configured. Figure 3a demonstrates how they are connected to the ZIF socket (zero insertion force programming socket), and figure 3b outlines their power source connections.

I designed a circuit that could be preset to the voltage limits of the desired EPROM.

8-BIT MICROCOMPUTER INTELLIGENCE

As I mentioned earlier, the CCSP's intelligence is provided by an Intel 8052AH microcomputer. BASIC-52 is particularly suited for this application,

(continued)

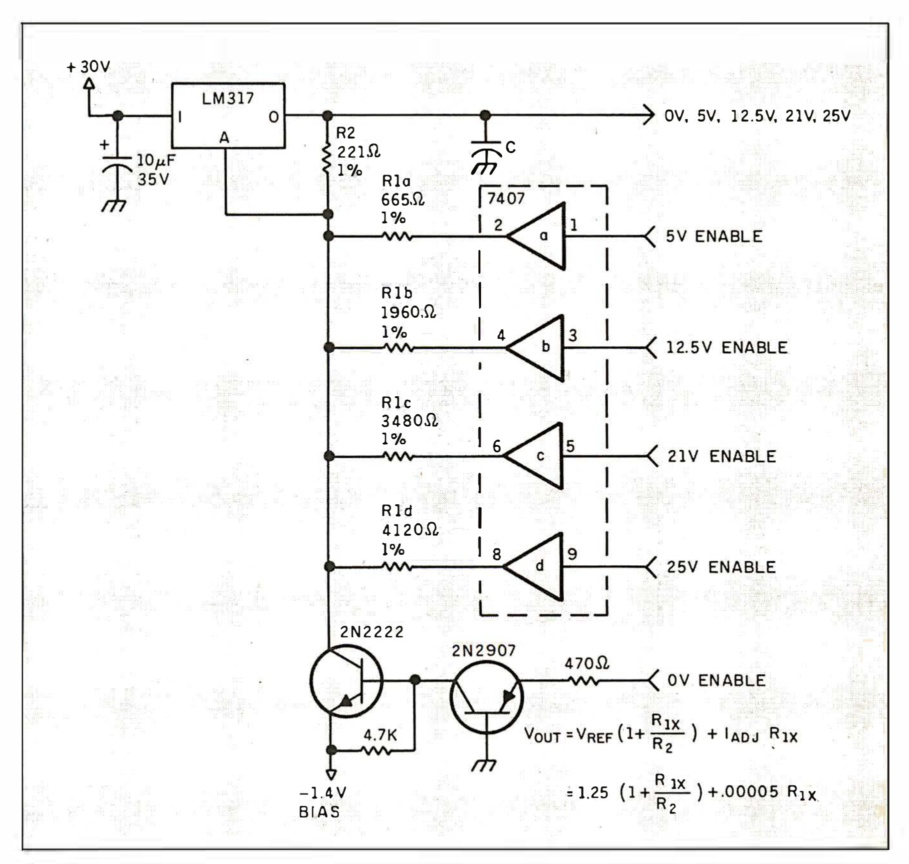


Figure 2: *Typical programmable voltage-control circuit for* EPROM *pins* 28, 26, 1, 22, *and* 23.

Three control lines— $\overline{\text{RD}}$, $\overline{\text{WR}}$, and $\overline{\text{PSEN}}$—are gated to allow 64K bytes of combined program and data memory.

providing IF. . .THEN, FOR. . .NEXT, DO. . .WHILE/UNTIL, ONTIME, and CALL statements as well as a broad repertoire of 8051 assembly language instructions. Calculations can be handled in integer or floating-point math.

The 8052AH contains an 8K-byte BASIC interpreter in ROM, 256 bytes of RAM, three 16-bit counter/timers, six interrupts, and 32 I/O lines that are redefined as a 16-bit address and an 8-bit data bus. A minimum of 1K byte of RAM is required for BASIC-52 to function, and any RAM must be located starting at 0000 hexadecimal. (I won't go into great detail on this computer since it closely resembles the BCC-52 presented in August 1985.) The microcomputer section of the CCSP is outlined in figure 4.

Three control lines—$\overline{\text{RD}}$ (pin 17), $\overline{\text{WR}}$ (pin 16), and $\overline{\text{PSEN}}$ (pin 29)—are gated to allow 64K bytes of combined program and data memory. The three most significant address lines (A13–A15) are connected to a 74LS138 decoder chip, IC4, which separates the addressable range into eight 8K-byte memory segments, each with its own chip select (Y0–Y7). The four most significant chip selects are connected to 8K-byte 6264 static RAMs, ICs 7–10. This area is the RAM buffer for reading or writing EPROMs. IC6, addressed at 0000 hexadecimal, must be another 6264 RAM for BASIC-52 to function. IC11 (2000–3FFF hexadecimal) contains the programmer software and is intended for either a 2764 or 27128.

All together, 56K bytes of memory are defined on the CCSP if you use five 6264 RAMs (as ICs 6–10) and a 27128 EPROM in IC11. To use the programmer, you need only the one RAM chip installed in IC6 (such a limited buffer area will require many passes to write or copy any large

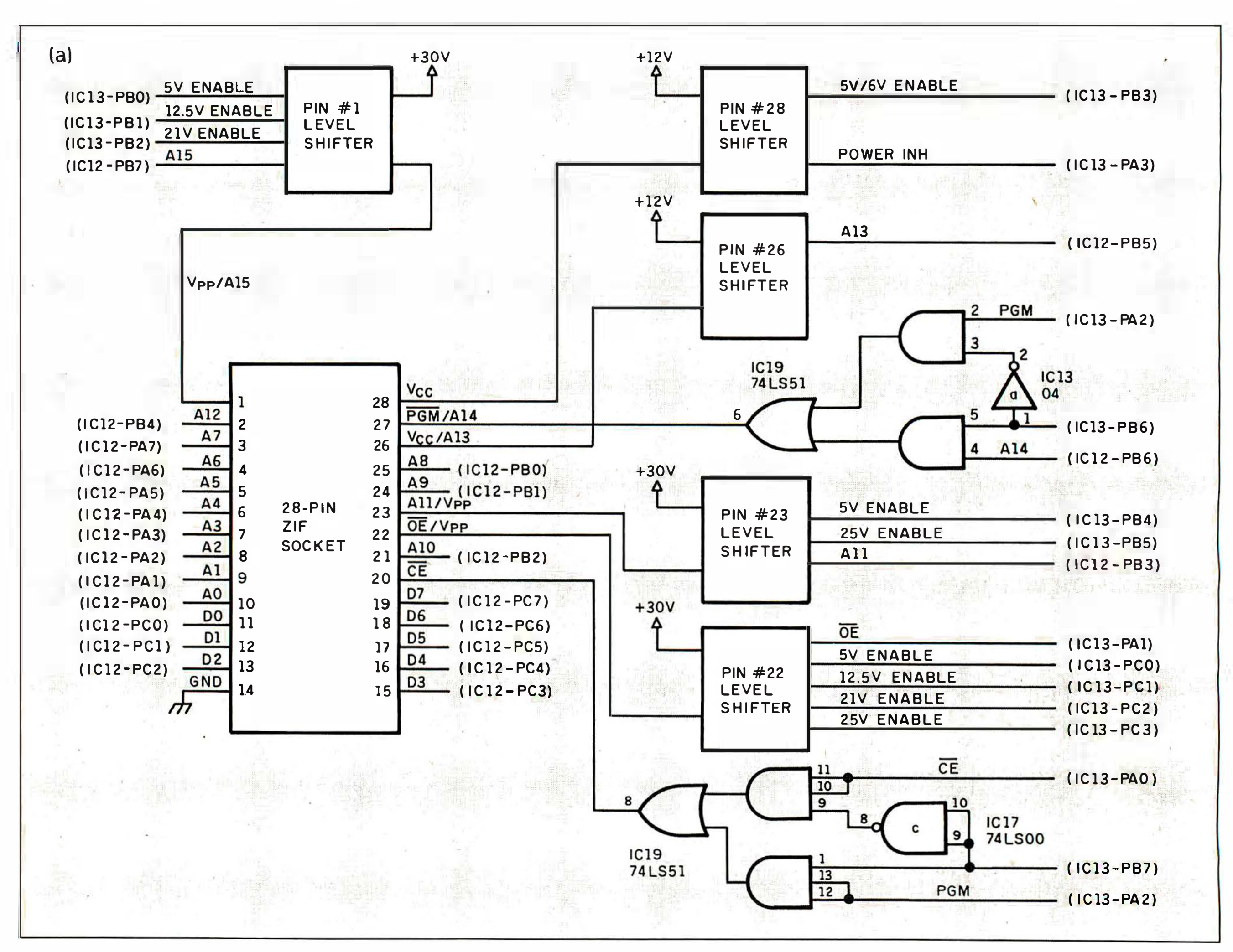


Figure 3: *(a) Block diagram showing the connections to the ZIF socket. Note the level-shifter circuitry connections for those pins that require programming voltages or that differ across EPROM types.*

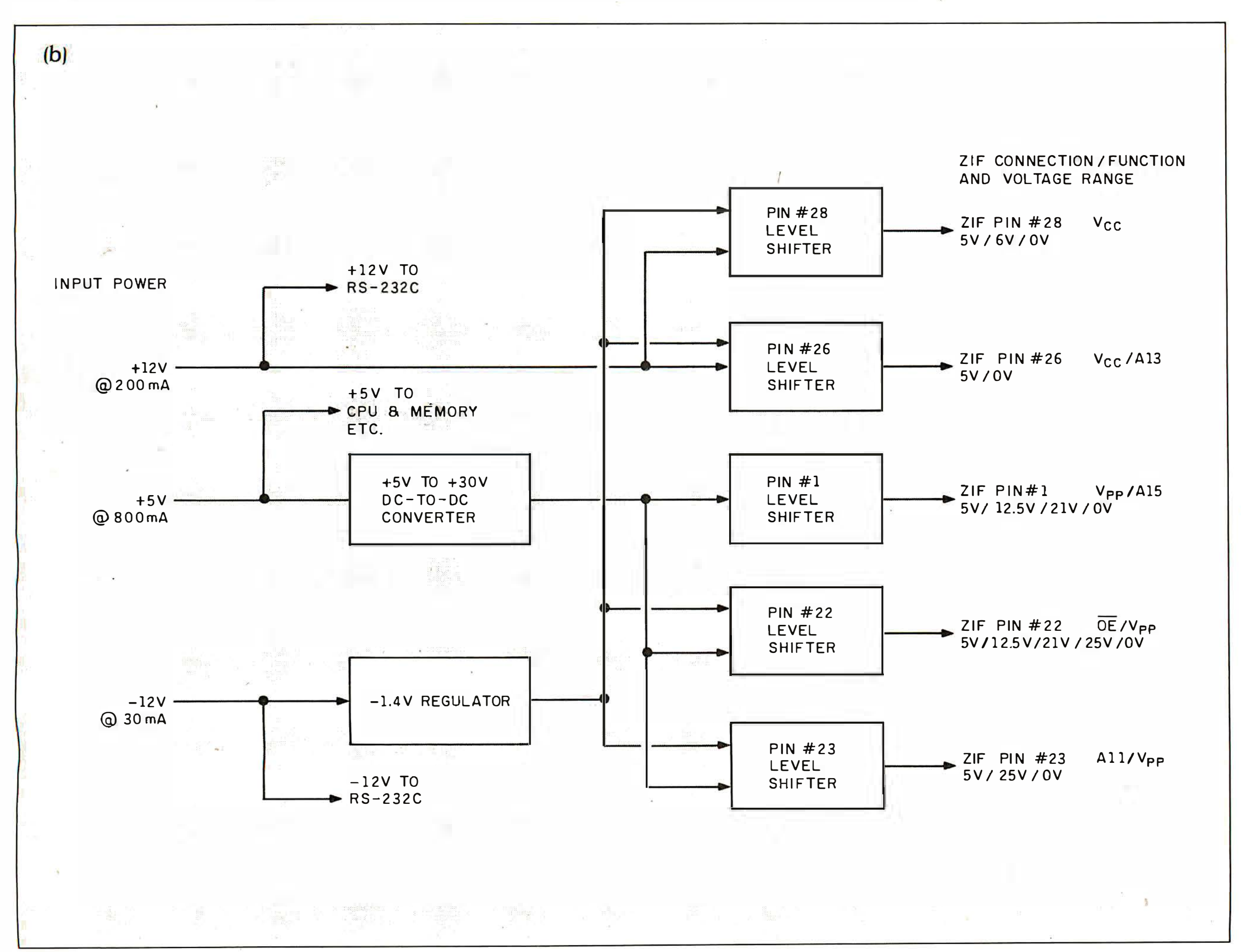
EPROM). The memory cannot be expanded since the rest of the address space is decoded as I/O.

The address range of 6000–7FFF hexadecimal is divided into two I/O strobes at 6000 and 7000 through IC17. [*Editor's note: For the remainder of the article, all addresses will be in hexadecimal.*] Two 8255A-5 peripheral interface adapters providing three 8-bit I/O parallel ports each are controlled by a strobe line. The three I/O ports—labeled A, B, and C—and a write-only mode-configuration port on each 8255 occupy four consecutive addresses at 6000–6003 (IC12) and 7000–7003 (IC13), respectively. The ZIF socket and level-shifting circuitry outlined in figure 2 are connected to 41 of these parallel I/O bits. The lines attached to IC12 (the control PIA) are used primarily for presetting the level shifters and providing the programming pulses. IC13 (the address and data PIA) supplies the address and data bus lines to the EPROM. Figure 5 details the configuration and connection of the level shifters and power distribution.

The CCSP communicates with a terminal or host computer through an on-board serial port. The port's data rate is hard-coded in the program ROM and is preset at 1200 bits per second, but you can reprogram it to any standard value between 300 and 19,200 bps. (The 8052AH chip has the capability for automatic data-rate selection on the console port. Because the CCSP has both a local and a remote operating capability triggered by the GET command, the automatic data rate cannot be used.) MC1488 and MC1489 drivers/receivers (ICs 14 and 15) convert the 8052's serial I/O line TTL logic levels to RS-232.

Power supplies with the required output are readily available, so I excluded an on-board supply to keep costs lower.

(continued)



(b) CCSP power-distribution block diagram.

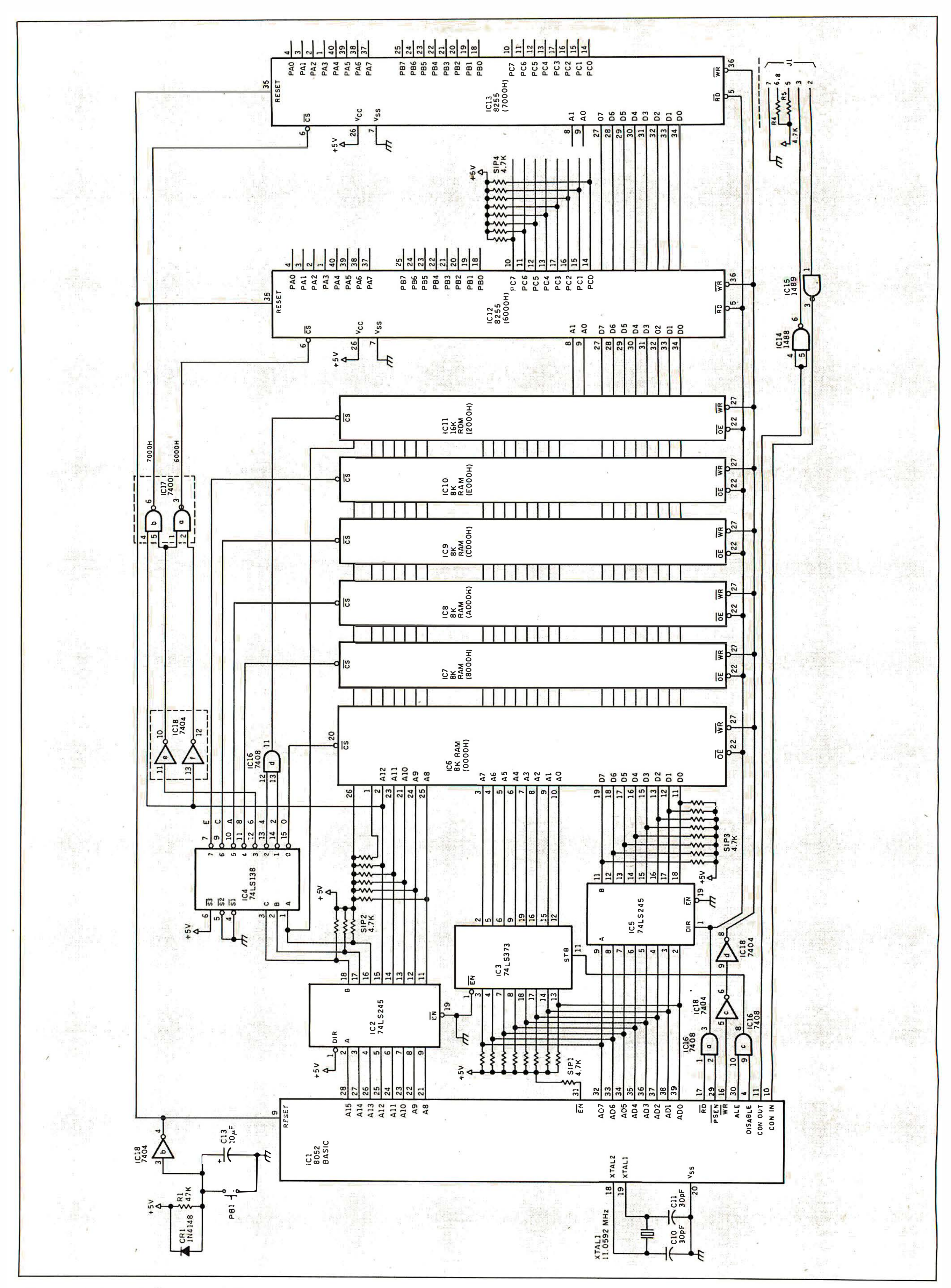


Figure 4: *Circuit diagram of the CCSP's microcomputer section.*

Power for the CCSP is provided by an external supply that must deliver +12 V at 200 mA, +5 V at 800 mA, and −5 V to −12 V at 30 mA. Power supplies with these outputs are readily available on the surplus market, so I excluded an on-board supply to keep costs lower. In fact, a perfect unit is the Coleco computer power supply available from Radio Shack for $4.95 (part #277-1022).

Three V_{pp} voltages must be contended with: 12.5 V, 21 V, and 25 V. All are derived from the +30-V output of the DC-to-DC converter circuit shown in figure 5. IC24 is a 78S40 switching regulator configured as a voltage multiplier. This circuit is capable of producing 30 V at 50 mA from a 5-V input. (For more information on this regulator and this specific circuit, see my November 1981 article, "Switching Power Supplies: An Introduction.")

The user entry/display interface is shown in figure 6. It consists of a two-button entry panel through which you operate the programmer in local mode, a local/remote LED indicator, EPROM power-on indicator, and a seven-segment display through which the computer displays EPROM type and errors. To save I/O bits, I used a somewhat unorthodox display driver rather than the usual parallel port and seven-segment decoder configuration. The seven-segment LED is attached to an 8-bit shift register that has each output connected to drive an individual segment and the decimal point. To display a character, the seven-segment information is extracted from a memory-resident table and quickly shifted into the shift register. Ordinarily, I wouldn't use such a software-intensive approach, but I didn't have to write the software.

Programmer Software

The CCSP is controlled by a program that is a combination of BASIC and 8051 assembly language. The BASIC-52 program provides all initialization and control functions, including local mode support and menu processing in the remote mode. The assembly language routines are used only where speed is critical, as in reading, comparing, verifying erasure, and programming EPROMs. In addition, the Intel hexadecimal file upload and download routines are written in

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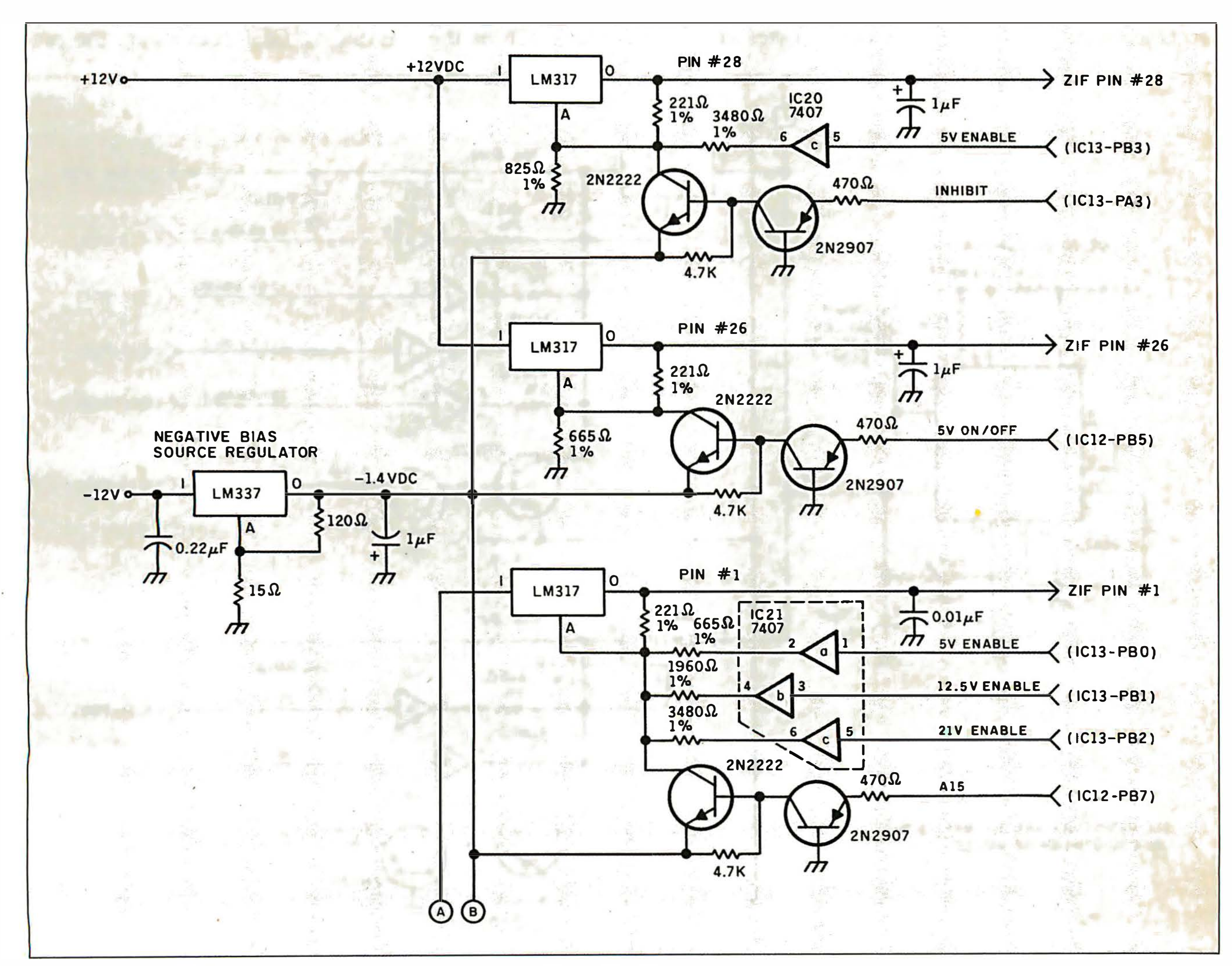


Figure 5: *Detailed schematic of the programmer's level-shifting circuitry.*

When working in local mode, you can copy any 27xxx EPROM by swapping the original and copy EPROMs multiple times.

assembly language to keep up with the attached ASCII terminal device. Figure 7 outlines the CCSP software logic flow.

The software that drives the CCSP is capable of running in two basic modes: local, where the CCSP acts as an EPROM copier controlled by buttons, and remote, where the CCSP acts as a full-featured programming workstation serially connected to the user's terminal. When working in local mode, you can copy any 27xxx EPROM regardless of its size by swapping the original and copy EPROMs multiple times. The larger the RAM buffer is, the fewer times you will have to change the EPROMs.

POWER-UP AND RESET

When the CCSP is first powered up or reset, its software configures itself for a 2716 EPROM, the default type. After setting up the hardware, the software outputs a 0 in the seven-segment LED display to indicate the EPROM type, turns on the local mode LED, and sizes the RAM buffer.

If no memory is located at 8000 (the buffer area), the CCSP allocates 4K bytes of system RAM in IC6 as the buffer area. If it is unable to accomplish this, it will stop and display an alternating error code, E and 0, in the seven-segment LED display. Pressing a button or sending a character to the serial port will force the CCSP to reattempt sizing memory (memory sizing is destructive). If you have RAM chips plugged into locations IC7 through IC10, this will provide additional buffer memory. After memory is sized, the CCSP enters a loop to determine what mode you want the programmer to operate in.

During the mode-setting loop, the CCSP will decide if it is going to run in local or remote mode. The mode selected is determined by which event occurs first: If one of the buttons is pressed first, the CCSP establishes local mode; if a character is detected at the serial port first (via the BASIC-52 GET command), the pro-

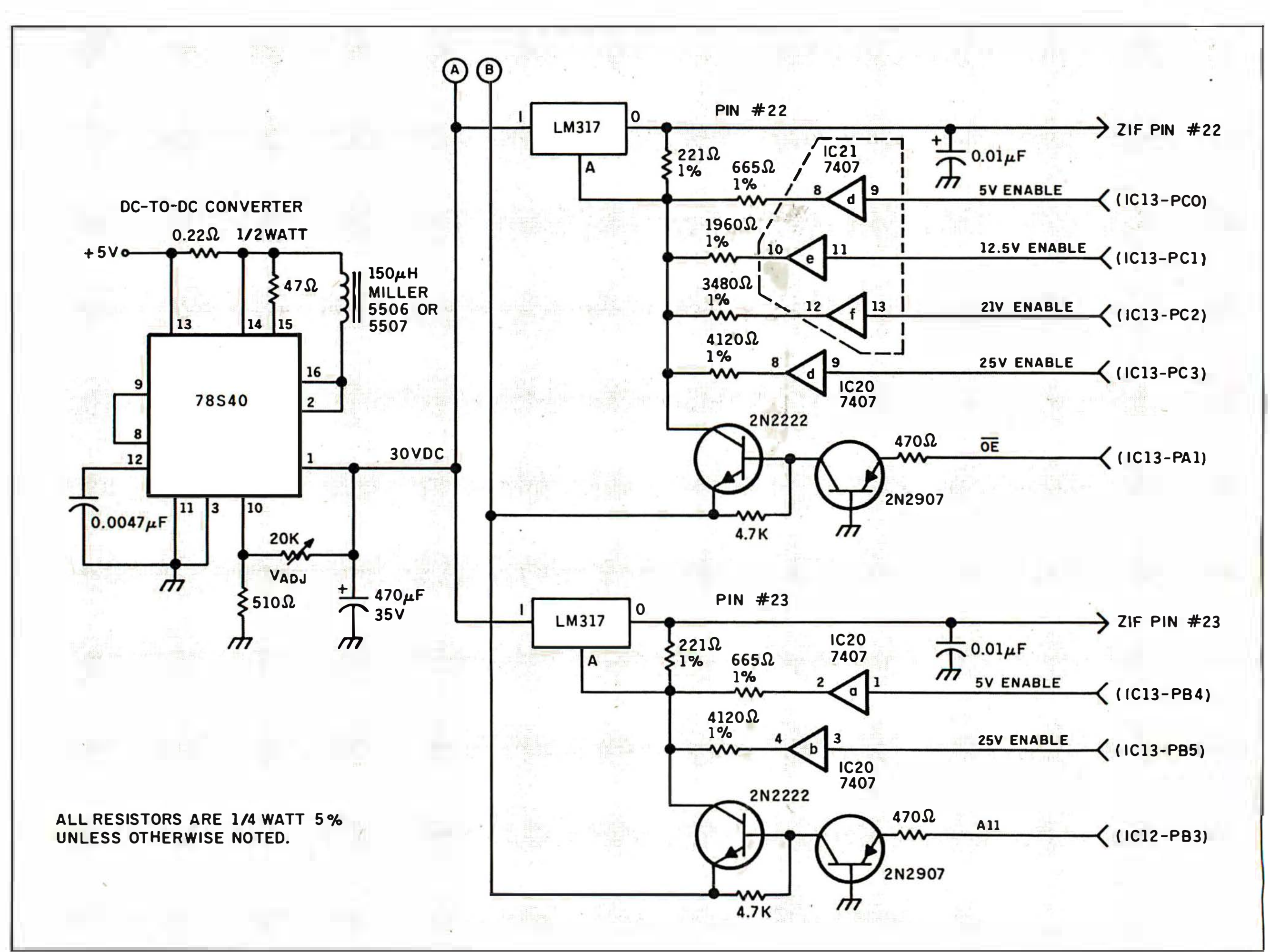


Figure 5 continued.

grammer enters remote mode. Once a mode has been selected, the CCSP must be reset or powered off/on to change modes.

STAND-ALONE LOCAL MODE

In local mode, the CCSP is controlled by two buttons called Type and Start/Next. Displays to the user are made via the seven-segment LED display. When local mode is initially entered, or at any point between completed programming cycles, you can change the designated EPROM type by pressing Type. Each press of the button steps the CCSP to the next EPROM type, and the seven-segment LED display is updated with the number that indicates the currently selected type. The designations are shown in table 1.

After setting the type of EPROM to work with, you begin the copy cycle by pressing Start/Next. At this point the seven-segment LED will display an alternating L and O, indicating that you should insert the original EPROM into the ZIF socket. You then load the original EPROM and press Start/Next again to begin the next step: reading the EPROM.

When the CCSP has read as much of the EPROM data as the memory buffer will allow, it signals you to remove the original EPROM and insert the copy EPROM by displaying an alternating L and C on the seven-segment display. After doing this, you again press Start/Next.

The CCSP will now attempt to program the contents of the RAM buffer into the copy EPROM. After verifying that the target area of the copy EPROM is erased, the letter "P" is displayed on the seven-segment display to indicate that programming is in progress (LED2 will be red, indicating that power is on to the EPROM and it should not be removed). When programming is complete, the contents of the EPROM are compared to the memory buffer contents. During this time, the letter "C" is displayed on the seven-segment display (LED2 will be green, indicating power off).

If the target EPROM is not erased or the programming was not successful (bad compare), the seven-segment LED will display an alternating E and a numeral, either a 1 for an unerased target EPROM or a 2 for a failed comparison. If an error does occur, you will be returned to the "between copies" state at the next press of the button.

Assuming all went well, the CCSP checks to see if the entire EPROM has been copied. If it has, the CCSP returns to the "between copies" state and displays the current EPROM type selected on the seven-segment display.

If the entire EPROM has not yet been copied, the effective starting address of the RAM buffer will be incremented by the size of the RAM buffer, and the CCSP will prompt you to insert the original EPROM again. This time, the programmer reads the EPROM starting at the new address. The amount of data read will be either the RAM buffer size or the remaining bytes to be copied from the EPROM, whichever is less. After reading the original, the CCSP calls for the copy EPROM, and programming continues as described above.

These steps will continue until the entire contents of the original EPROM have been transferred into the copy EPROM. Using this approach allows any size EPROM to be copied, regardless of the amount of memory in the RAM buffer.

REMOTE MODE OPERATION

When used in remote mode, the CCSP turns into a menu-driven programming workstation, controlled by an

(continued)

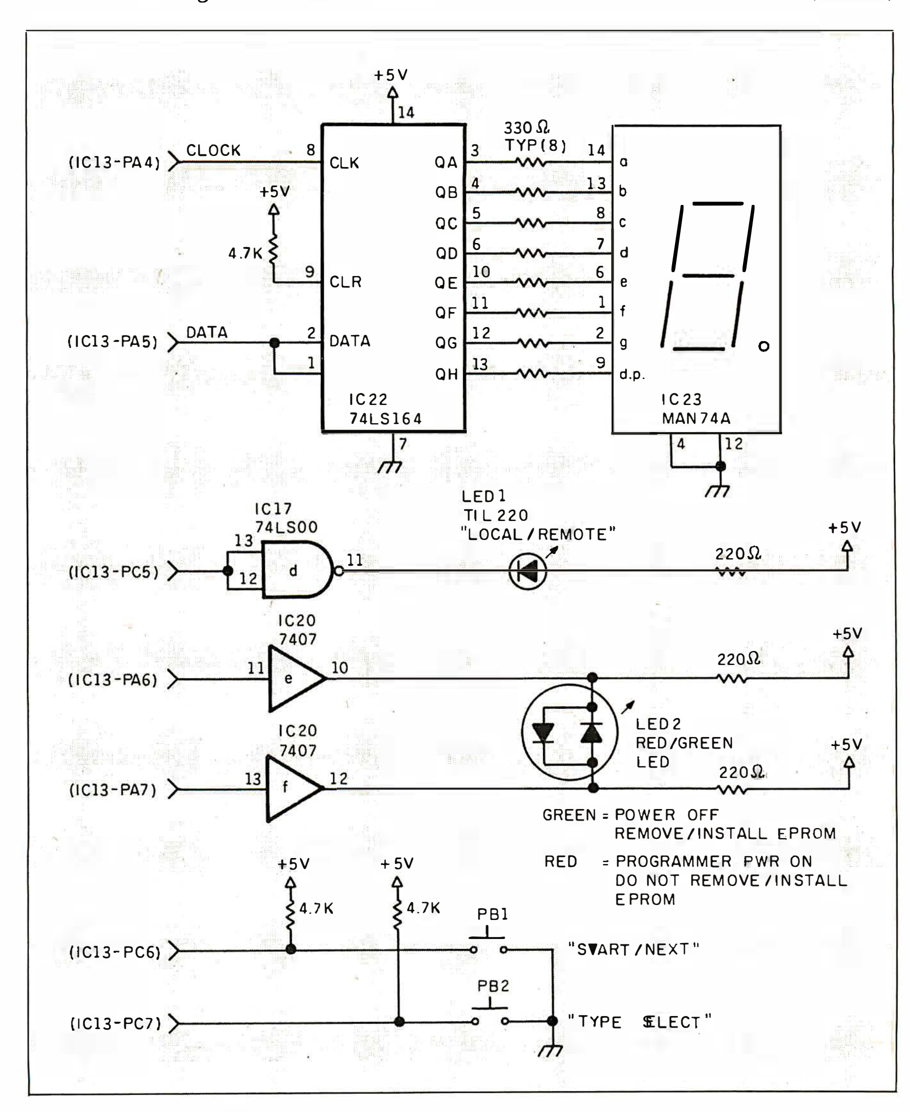


Figure 6: *The CCSP's entry/display circuit.*

All menus displayed on the terminal are generated by the CCSP. A terminal-emulation program is the only software necessary to use this programmer.

ASCII terminal. (See photo 2.) The data rate of the terminal must be hard-coded because the 8052 cannot automatically start the BASIC-52 program unless the data rate is defined. Using the automatic data-rate feature causes the 8052 to wait for a "space" character from the serial port before executing any program stored in it; this would eliminate the local mode of the CCSP. The data rate is set at 1200 bps, but you can change it to any standard value by reprogramming the system ROM with the default data-rate byte changed (details on this procedure are included with the software).

All the menus displayed on the screen of the terminal or computer are generated by the CCSP. No software other than a terminal-emulation program (if connected to a computer rather than a real terminal) is necessary to use this programmer. The remote mode menu provides the following options:

- read, compare, program, and verify EPROM
- display and change RAM buffer contents
- download and upload Intel hexadecimal files
- set EPROM type
- set effective starting address of the RAM buffer

The menu screens contain enough information to guide you through the use of most of these functions. Other pertinent information on the various options is given below.

Read, compare, program, and verify EPROM all depend on the RAM buffer, and they usually use the effective starting address and the length of the RAM buffer to determine the area of the EPROM that is being worked with. Think of the RAM buffer as a window into the contents of the EPROM. If the RAM buffer is not large enough to show you the whole EPROM, you can move it around by changing its effective starting address.

Let's use an example. The EPROM type is a 27512, which is 64K bytes, and the RAM buffer is 16K bytes. It should be pretty obvious that you can't get the whole 27512 into the RAM buffer at the same time. In this case, you would set the starting address of the RAM buffer to 0000 to work with the first quarter of the EPROM and then set it to 4000 to work with the second quarter, 8000 for the third, and C000 for the last. The READ, COMPARE, and PRO-

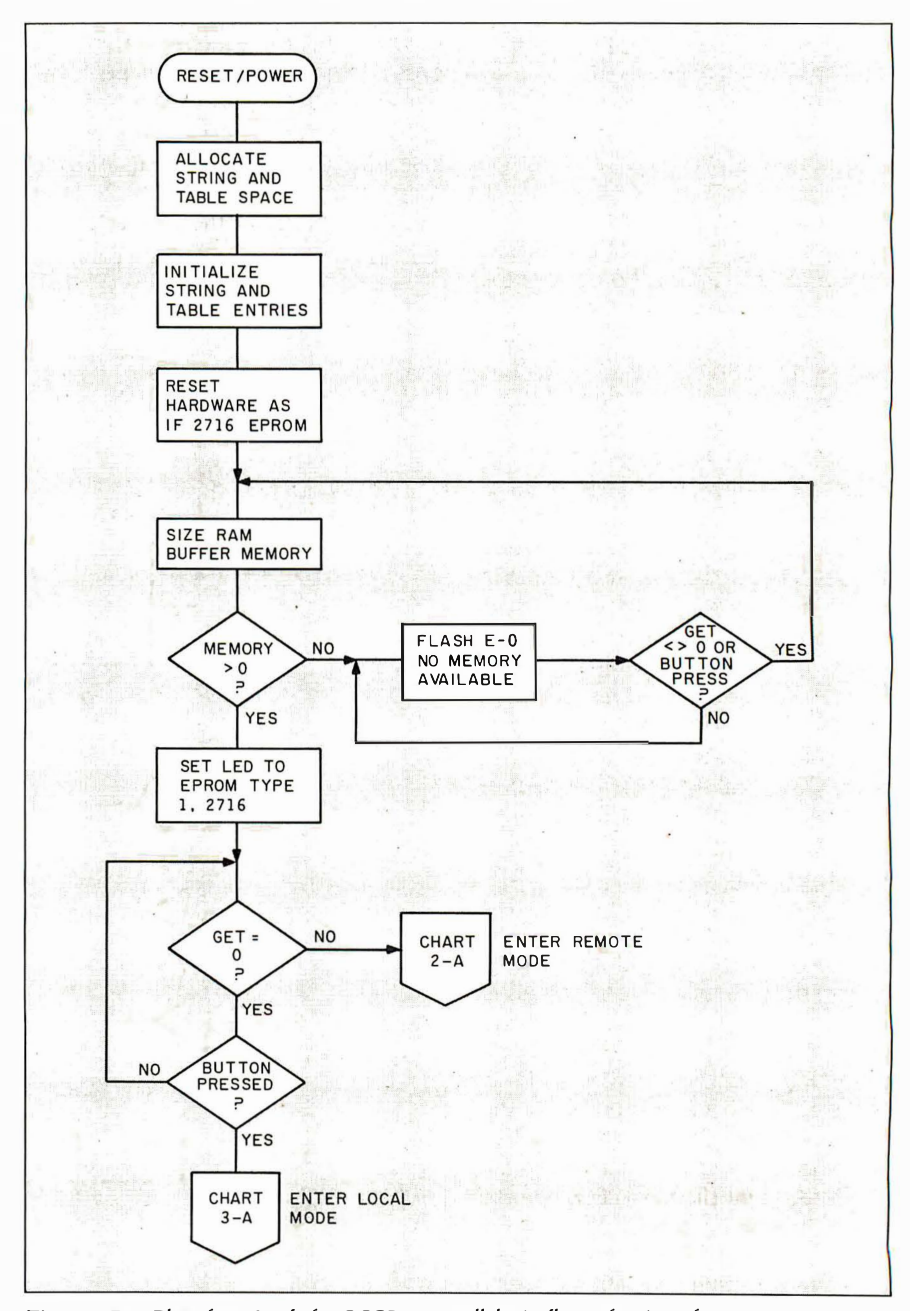


Figure 7a: *Flowchart 1 of the CCSP's overall logic flow, showing the power-up and reset routines.*

GRAM commands would use the starting address of the RAM buffer to see where to read data from or write data to the EPROM. The greatest length of the transferred data would be the size of the RAM buffer or the remaining number of bytes in the EPROM, whichever was smaller.

Even though the VERIFY command does not care about the size of the buffer, its default start and end addresses are controlled as described above. This is because VERIFY generally precedes a programming cycle (you use VERIFY to confirm that the EPROM is properly erased), and the RAM buffer addressing controls programming default start and end addresses.

The following functions—display and change RAM buffer contents and download/upload Intel hexadecimal files—are also tied into the RAM buffer. Since the RAM buffer is supposed to mirror the equivalent area of the EPROM, displays, changes, and uploads/downloads must be addressed to the RAM buffer, just as they would be in the real EPROM. This means that the software will reject addresses outside the range of the current RAM buffer area, which is especially important when doing uploads and downloads. These loads *must* be broken up to fit into the current RAM buffer area

(continued)

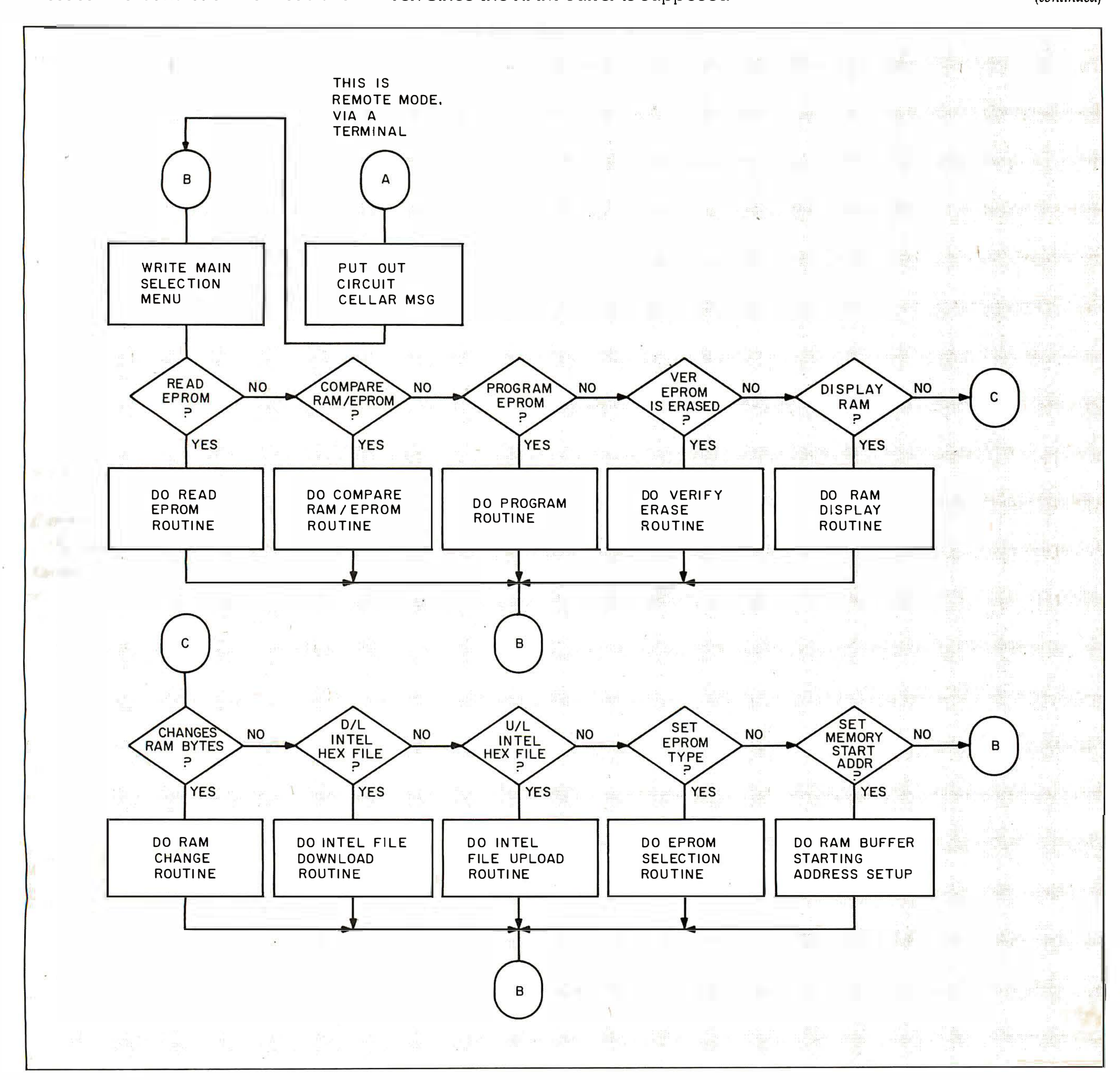


Figure 7b: *Flowchart 2, logic flow for the remote mode.*

Table 1: *The CCSP's EPROM selection number and corresponding EPROM types. Note that this list is of generic EPROM types, and other manufacturer designations should be cross-referenced to it. Also, since CMOS programming cycles are equivalent to those in standard EPROMs, separate 27Cxxx designations are not included.*

Number	EPROM	Type	Number	EPROM	Type
0	2716	25 V	5	27128	21 V
1	2732	25 V	6	27128A	12.5 V
2	2732A	21 V	7	27256	12.5 V
3	2764	21 V	8	27512	12.5 V
4	2764A	12.5 V			

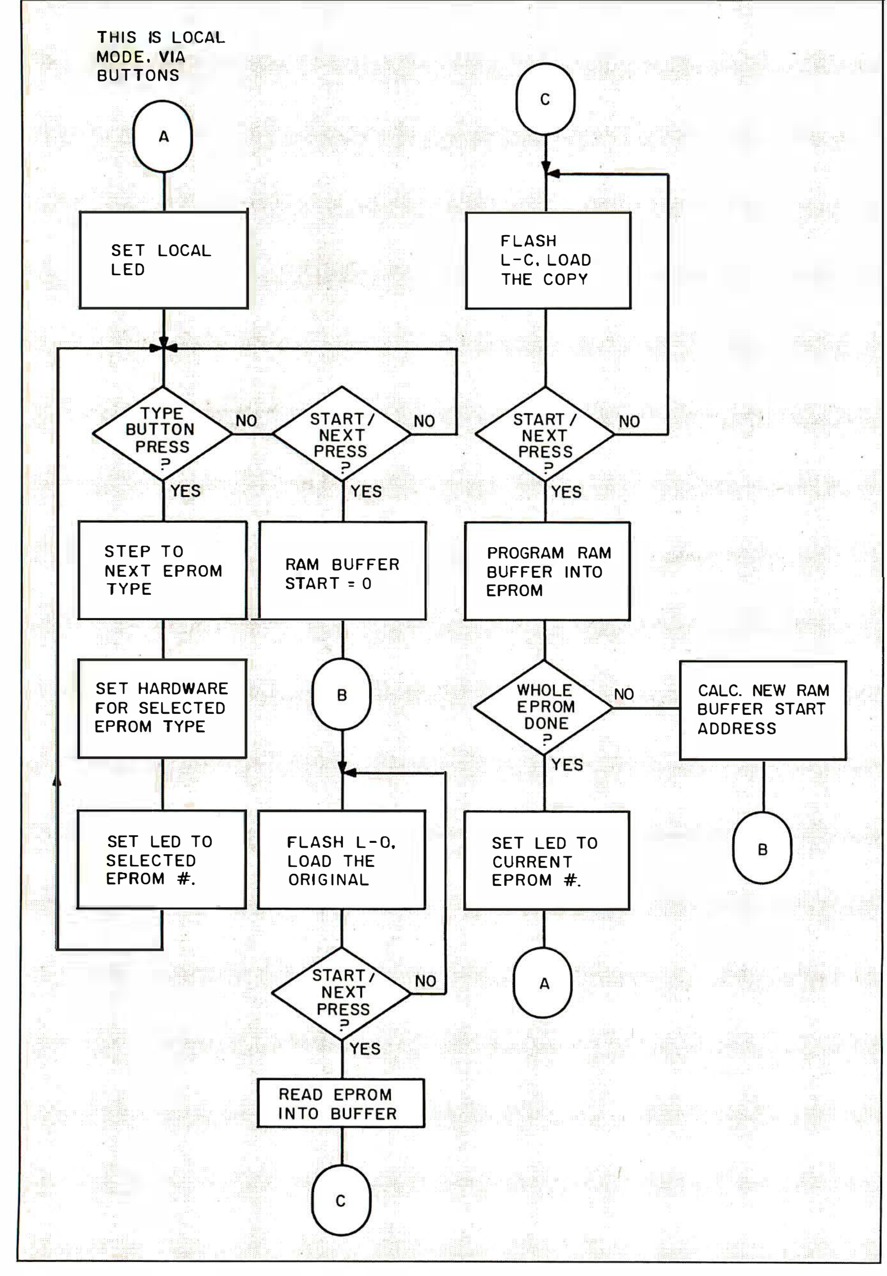


Figure 7c: *Flowchart 3, logic flow for the local mode.*

address range. Trying to go outside the range will abort the display/change/load processes.

The remaining two functions—set EPROM type and set RAM buffer starting address—let you deal with various EPROM types and manipulate the starting address of the RAM buffer. Setting the RAM buffer address lets you change the location of the window into the EPROM. This should be necessary only if the size of the EPROM exceeds the size of the RAM buffer. Otherwise, there is no reason to change the starting address from its default value of 0000.

Under the Covers

In order to handle the various combinations of sizes, programming voltages, and control lines used with different EPROM types, the software incorporates control tables. Four such tables are used in the CCSP:

- system global table G(*x*)
- LED character table L(*x*)
- EPROM string table $(*x*)
- EPROM data table E(*x*)

System Global Table

The system global table contains information about current values for critical system information. The table's entries are set up as is shown in table 2.

The values for these items change based on the type of EPROM you are using, how much contiguous memory is at address 8000 (or the 4K bytes stolen from system RAM), and the last bytes written to the 8255s.

LED Character Table

The seven-segment LED display is controlled by a serial-to-parallel shift register. In order to create a character in the LED, the bits for the various segments must be shifted out in the correct order. This table contains the LED code byte needed to create the characters that can be displayed (see table 3).

EPROM String Table

BASIC-52 does not allow the mixing of text and numeric data in the same table, so the $(*x*) string table function is used to store this information. This

table contains the EPROM designator and the programming voltage used with that type of EPROM. Actually, the programming voltage indicated in the table is only a reminder. You have to set the correct bits in the EPROM data table to ensure that the programmer uses the proper voltage.

EPROM Data Table

The EPROM data table contains all the information the system requires to work with the different EPROM types. The items in each record of the EPROM data table are shown in table 4.

Listing 1 illustrates how this is handled in BASIC. This data is maintained for the use of both the BASIC and assembly language routines. BASIC passes data from the EPROM data table to the assembly language routines via the free registers of the 8052 device.

The Assembly Language Routines

The CCSP software is a hybrid of BASIC and assembly language. Besides reading and verifying, the EPROM programming pulses are accurately timed in assembly language routines. The derivation of the timing's accuracy is given in table 5.

In Conclusion

At first look, the CCSP appears to be considerably more complicated than my programmer of 18 months ago. I think at this point I can change my new description to more accurately state that "this programmer is a serial-port programmer that has the speed of lightning, the intelligence of the mightiest computer (on-board), and is far too functional to be used as a doorstop between uses."

In actuality, only the explanation is more involved. With microcomputer intelligence, the CCSP achieves performance levels approaching kilobuck commercial units yet is flexible enough to be adapted to the next V_{pp} change when it happens.

I'm quite satisfied with my two-week miracle, but I still have to contend with a potential horde of builders. To make amends for my past indiscretion,

(continued)

Table 2: *Contents of the system global table.*

Index	Use
0	Type number of the current EPROM.
1	Amount of RAM buffer available in 256-byte increments. increments.
2	Current starting address of RAM buffer.
3	Number of items in EPROM table entry.
4	Reserved.
5,6,7	Value of the last data byte written to IC12 address/data PIA (3 bytes, one for each port of the 8255).
8,9,10	Value of the last data byte written to IC13 control PIA.
11	Number of EPROM types in the EPROM string and data tables.

Table 3: *Contents of the* LED *character table.*

Index	Use
0–9	Characters 0–9 (no decimal point)
10–15	Characters A–F (no decimal point)
16–25	Characters 0–9 (decimal point)
26–31	Characters A–F (decimal point)
32	Blanks LED
33	Character H
34	Character L
35	Character P
36	Character U

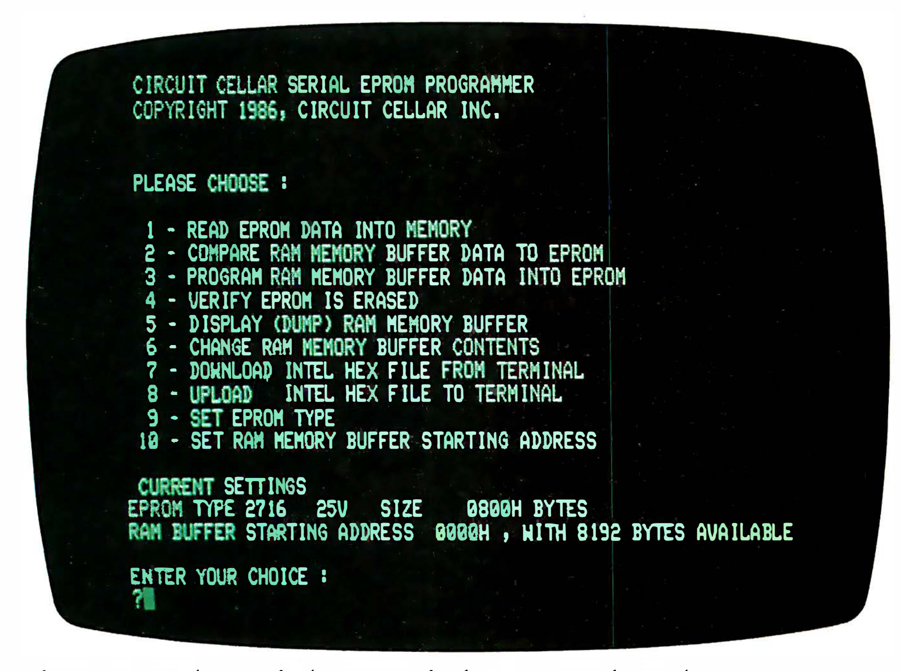


Photo 2: *Typical menu display presented when operating the serial* EPROM *programmer through a serial terminal or computer running in terminal-emulation mode.*

Table 4: *Contents of the EPROM data table.*

Index	Use
0	Number of the EPROM.
1	Size of the EPROM in 256-byte increments.
2	The pin V_{cc} is applied to, referenced to a 28-pin socket.
3,4,5	The initialization values for IC13 control PIA's ports A, B, and C.
6,7	The programming mode values for IC13's ports A and B.
8	Logic true value of the programming pin (CE and PGM).
9	Normal mode programming pulse width in milliseconds.
10	Fast mode programming pulse in milliseconds (0 if no fast programming allowed).
11	Maximum number of fast programming pulses before forced overprogram pulse occurs.
12	Overprogram pulse multiplication factor.

Table 5: *Derivation of the timing for the CCSP's 1-ms timing routine.*

Label	Instruction	Frequency of Execution	Clock Periods Used
PPLOOP	EQU $	A	0
	PUSH B	C	24
	CALL ONEMS	C	24
	POP B	C	24
	DJNZ B,PPLOOP	C	24
	RET	O	24
ONEMS	EQU $	A	0
	MOV B,#MSDLAY	C	24
MSLOOP	EQU $	A	0
	NOP	L	12
	NOP	L	12
	DJNZ B,MSLOOP	L	24
	RET	C	24
MSDLAY	EQU 227	A	0
	END	A	0

Frequency codes:
A—Assembler only, not executed
C—Executed once per 1-ms count
O—Executed only once per entry to subroutine
L—Executed in each loop of the 1-ms routine

Timing Calculations:

1MS=11059.2 clock periods (clock is 11059200 Hz)

$11059.2 = 24 + (24+24+24+24+24+24) + N(12+12+24)$

$11059.2 = 168 + (N \times 48)$

$(11059.2 - 168)/48 = N$

$N = 226.9$ (round to 227)

Error for 1-ms pulse is $0.1 \times 48 \times (1/11059200) = 0.000443$ ms

Cumulative error for 100-ms pulse is:

$$\frac{1105920-24-14400}{4800} = 227.395 \text{ (use 227)}$$

$0.395 \times 48 \times (1/11059200) = 0.00171$ ms

Listing 1: *The* BASIC-52 *code to initialize the* EPROM *data table.*

```
14170 REM
14180 REM INITIALIZE EPROM DATA TABLE
14190 REM
14200 FOR X=0 TO A:READ E(X):NEXT X
14210 REM  TYPE SIZE PWR 7XPA 7XPB 7XPC 7PCP 7PBP PLV NPL FP FXP FACTR
14220 DATA 2716,008H,026,0BBH,061H,001H,008H,000H,001,050,000,000,000
14230 DATA 2732,010H,026,0BFH,051H,001H,008H,000H,000,050,000,000,000
14240 DATA 2732,010H,026,0BFH,051H,001H,004H,000H,000,050,000,000,000
14250 DATA 2764,020H,028,0BFH,014H,001H,000H,000H,000,050,001,025,003
14255 DATA 2764,020H,028,0BBH,012H,001H,000H,000H,000,050,001,025,003
14260 DATA 27128,040H,028,0BBH,014H,001H,000H,000H,000,050,001,015,004
14265 DATA 27128,040H,028,0BBH,012H,001H,000H,000H,000,050,001,015,004
14270 DATA 27256,080H,028,0BBH,052H,001H,000H,000H,000,050,001,025,003
14280 DATA 27512,0100H,028,0BBH,051H,002H,000H,000H,000,050,001,025,003
14281 REM SET UP EPROM NAME TABLE
14283 $(1)="2716   25V  "
14284 $(2)="2732   25V  "
14285 $(3)="2732A  21V  "
14286 $(4)="2764   21V  "
14287 $(5)="2764A  12.5V"
14288 $(6)="27128  21V  "
14289 $(7)="27128A 12.5V"
14290 $(8)="27256  12.5V"
14291 $(9)="27512  12.5V"
14295 RETURN
```

there is indeed a printed circuit board and kit for this programmer. For those of you with the components at hand and a desire for wire-wrapper's cramp, the finished code for the programmer is available on a 27128 EPROM or is downloadable from the Circuit Cellar BBS and BYTEnet Listings. The phone number for BYTEnet Listings is (617) 861-9764. This file contains the 12K bytes of executable code that should be put into a 27128 EPROM and installed in IC11.

Circuit Cellar Feedback

This month's feedback begins on page 58.

Next Month

Build the GT180 professional graphic adapter for the SB180. ■

Special thanks to Bill Curlew for his software expertise.

There is an on-line Circuit Cellar bulletin board system that supports past and present projects. You are invited to call and exchange ideas and comments with other Circuit Cellar supporters. The 300/1200/2400-bps BBS is on-line 24 hours a day at (203) 871-1988.

Editor's note: Steve often refers to previous Circuit Cellar articles. Most of these past articles are available in book form from BYTE Books, McGraw-Hill Book Company, P.O. Box 400, Hightstown, NJ 08250.

Ciarcia's Circuit Cellar, Volume I covers articles in BYTE from September 1977 through November 1978. *Volume* II covers December 1978 through June 1980. *Volume* III covers July 1980 through December 1981. *Volume* IV covers January 1982 through June 1983. *Volume* V covers July 1983 through December 1984.

The following items are available from

CCI
P.O. Box 428
Tolland, CT 06084

1. Serial EPROM programmer experimenter's kit. Includes PC board, 8052AH-BASIC chip, 11.05-MHz crystal, operating system software on preprogrammed 27128 EPROM, manual, and detailed parts list. $89
2. Complete serial EPROM programmer kit. Includes all board-mounted components, programmed 27128 EPROM, 8052AH microprocessor, and manual. Less case and power supply $199
3. Preprogrammed 27128 EPROM containing serial EPROM programmer system software $22

The serial EPROM programmer is currently available only in kit form. It is available assembled and tested only in volume OEM quantities (telex: 643331). Price and delivery information available on request.

All payments should be made in U.S. dollars by check, money order, MasterCard, or Visa. Surface delivery (U.S. and Canada only): add $5 for U.S., $10 for Canada. For delivery to Europe via U.S. airmail, add $20. Three-day air freight delivery: add $8 for U.S. (UPS Blue), $25 for Canada (Purolator overnight), $45 for Europe (Federal Express), or $60 (Federal Express) for Asia and elsewhere in the world. Shipping costs are the same for one or two units. Connecticut residents please include 7.5 percent sales tax.

Most of the individual components are available from JDR Microdevices, 1224 South Bascom Ave., San Jose, CA 95128, (800) 538-5000.

To be included on the Circuit Cellar mailing list and receive periodic project updates and support materials, please circle 100 on the Reader Service inquiry card at the back of the magazine.

Escort Refuses!

Dear Customer, ***From: Drew Kaplan***

Escort turned down our $10,000 head to head challenge described below. Escort says that Maxon's Radar Detector is "primitive", "bottom-end" and "an off-shore produced electronics 'gadget' ". I don't know about you, but to me these words conjure up visions of a cheap toy being produced off in the middle of a rice paddy somewhere in the middle of nowhere.

Escort, on the other hand, which is made in the U.S., exudes a high cost, quality image. Don't you just bet that it costs a fortune to build Escort and Passport (the smaller version)?

Well, we are going to challenge Escort **AGAIN** to a head to head 'duel to the death' on Maxon's electronic merits alone. And, we plan to win. But first there are a few things you should know.

Cincinnati Microwave, the company that makes Escort & Passport, is a public company. And being public, they have to file financial information with the SEC.

The public information they have published appears to show that in the year that ended Dec. 1985, Cincinnati Microwave with "substantially all of its revenues and profits derived from the sale of radar warning receivers" made an operating profit of about $45,810,000 on sales of about $112,605,000. Wow!

The $45 million profit is after all engineering, selling and General & Administrative expenses, but before taxes.

Their cost of sales (goods) was only about $40,027,000. So, if you divide $40,027,000 by $112,605,000 it doesn't take a genius to figure out that cost of goods represents an average of only about 35.5% of selling price. Wow!

I only bring up their profit to illustrate that a high retail price doesn't always mean a high manufacturing cost.

There's no question in my mind that Maxon can manufacture cheaper in an off-shore 'rice paddy', but if you pay $245 for Escort or $295 for Passport, it should be based on a head to head test with Maxon, not on perceived retail price points.

FORGET PRICE COMPLETELY

So, forget that Escort costs $245, Passport $295, and Maxon $99⁹⁰. Let's judge them on their own merits. And, let's look at just what Escort itself has to say about our challenge. (Please read DAK's and Escort's letters to the right.)

Escort says that, **"Regardless** of the results, such an event lends credibility to the challenger." Well, they are absolutely correct. That's why I put up the $10,000 in the first place. Fair is fair.

Plus, there are several radar detectors that claim to have won this or that ranking in "Independent Magazine Reviews." So, I'm ignoring any reviews and asking for a one on one, head to head test.

But look at what Escort says in their letter: "Range is the easiest detector quality to measure, but by no means the only important quality." Wow, I thought range was really important?? Escort refers to "goodness" being determined by things not so easily measured.

Well frankly, I don't know how to measure "goodness". Escort, in my opinion, is a top notch company. They make a superb product I'd be proud to sell. And, they have great customer service.

DAK has great toll free technical and regular customer service. But, I'd be the first to admit that with over $45 million in profits, Escort can probably run circles around us in advertising, and maybe even in service. But, I don't think they can beat Maxon's Radar Detector.

HOW GOOD IS GOOD?

When Escort was introduced, it was revolutionary. But, you can only go so far. And in my opinion (someone else might object), radar detecting has gone about as far as it can go. So, while Escort has made improvements, it's Maxon who has moved mountains to catch up.

DAK UPs THE ANTE TO $20,000

Now I realize that next to $45 million dollars, $20,000 isn't much, but it's a lot to DAK. And, I'll even go one step farther. I'll print the exact results of the test, win, lose, draw, or no-show in the first catalog I publish after January 1, 1987.

Escort, the ball is now in your court. Below is the **"NEW"** version of my challenge with the time and amount changed.

I don't know what else DAK or Maxon can do to prove that the RD-1 Superheterodyne Detector should be judged on its head to head performance against Escort, not on its selling price!

WAS $10,000

A $20,000 Challenge To Escort

Let's cut through the Radar Detector Glut. We challenge Escort to a one on one Distance and Falsing 'duel to the death' on the highway of their choice. If they win, the $20,000 (was $10,000) check pictured below is theirs.

By Drew Kaplan

We've put up our $20,000 (was 10). We challenge Escort to take on Maxon's new Dual Superheterodyne RD-1 $99⁹⁰ radar detector on the road of their choice in a one on one conflict.

Even Escort says that everyone compares themselves to Escort, and they're right. They were the first in 1978 to use superheterodyne circuits and they've got a virtual stranglehold on the magazine test reports.

But, the real question today is: 1) How many feet of sensing difference, if any, is there between this top of the line Maxon Detector and Escort's? And 2) Which unit is more accurate at interpreting real radar versus false signals?

So Escort, you pick the road (continental U.S. please). You pick the equipment to create the false signals. And finally, you pick the radar gun.

Maxon and DAK will come to your highway with engineers and equipment to verify the results. And oh yes, we'll have the $20,000 check (pictured) to hand over if you beat us by more than 10 feet in either X or K band detection.

BOB SAYS MAXON IS BETTER

Here's how it started. Maxon is a mammoth electronics prime manufacturer. They actually make all types of sophisticated electronic products for some of the biggest U.S. Electronics Companies. (No, they don't make Escort's).



Bob Thetford, the president of Maxon Systems Inc., and a friend of mine, was explaining their new RD-1 anti-falsing **Dual** Superheterodyne Radar detector to me. I said "You know Bob, I think Escort really has the market locked up." He said, "Our new design can beat theirs".

So, since I've never been one to be in second place, I said, "Would you bet $20,000 (10) that you can beat Escort?" And, as they say, the rest is history.

By the way, Bob is about 6'9" tall, so if we can't beat Escort, we can sure scare the you know what out of them. But, Bob and his engineers are deadly serious about this 'duel'. And you can bet that our $20,000 (was $10,000) is serious.

. . .Next Page Please

. . .Challenge Continued

We ask only the following. 1) The public be invited to watch. 2) Maxon's Engineers as well as Escort's check the radar gun and monitor the test and the results.

3) The same car be used in both tests.

4) We'd like an answer from Escort no later than December 31, 1986 and 60 days notice of the time and place of the conflict. And, 5) We'd like them to come with a $20,000 (was $10,000) check made out to DAK if we win.

into action in just 1/4 of one second.

Just imagine the sophistication of a device that can test a signal 4 times in less than 1/4 of one second. Maxon's technology is mind boggling.

But, using it isn't. This long range detector has all the bells and whistles. It has **separate** audible sounds for X and K radar signals because you've only got about 1/3 the time to react with K band.

There's a 10 step LED Bar Graph Meter to accurately show the radar signal's

DAK INDUSTRIES INCORPORATED

June 2, 1986

Mr. Paul M. Allen
Cincinnati Microwave
One Microwave Plaza
Cincinnati, OH 45249-9502

Dear Mr. Allen:

Enclosed is a copy of a letter you sent to one of DAK's potential customers. I have been patiently waiting for a direct response from you, and quite frankly, I'm disappointed that you have chosen not to respond directly.

I'm also disappointed with the sensitivity tests that you've quoted because, quite frankly, they don't measure up to Maxon's. And, they've tested and compared about six of your units for consistency.

Finally, I resent your referring to our challenge simply as an advertising gambit. And Maxon and DAK take extreme exception to being referred to as "primitive and bottom-end". Your own ads state that you're the one to beat and now that you've really been challenged (probably for the first time), it seems that you are backing out.

You mention in your letter that $10,000 is a modest amount. What would you consider a suitable amount of money, that would not be considered modest, to get you to come out on the highway for a head to head test?

After all, what do you have to lose if you win? We're even willing to come to you. You don't even have to leave your own home turf. So, your costs would be "modest" to use your word.

If I haven't heard from you within the next 10 days, which by the way, is extending our challenge beyond June 1, I can only assume that outside of your laboratory, on the road where it really counts, you don't think you can beat Maxon. We expect to win or, at the very least, tie within ten feet.

Sincerely,
DAK INDUSTRIES, INC.
Drew Alan Kaplan
President

DAK:vp
Enclosure

To Order: TOLL FREE (800) 325-0800 Customer Service: TOLL FREE (800) 42
8200 Remmet Ave., Canoga Park, CA 91304, USA • In Los Angeles call 213-82

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Cincinnati, Ohio 45249-9502
513 489-5400

RECEIVED

June 9, 1985

Mr. Drew Kaplan
DAK Industries
8200 Remmet Avenue
Canoga Park, CA 91304

Dear Mr. Kaplan,

I must admit I was surprised to find that you have been "patiently waiting for a direct response from me. Had I received a direct inquiry from you I would have certainly responded.

As to my reference to your challenge as an "advertising gambit", I did not intend this as an insult. As a fellow student of Mr. Sugarman, I have realized for some time that something like your challenge would be a clever theme for any of our "competitors" to use. I am only surprised it took as long as it did.

I will say, however, that we have no intention of participating in any one-on-one challenge with your firm or any other firm. Regardless of the results, such an event lends credibility to the challenger. But then, I'm not telling you anything you don't already know.

Also, the limited nature of your challenge by no means fully evaluates a detector's "goodness". Range is the easiest detector quality to measure, but by no means the only important quality. I am sure any of our customers would be glad to explain further.

Several independent sources periodically compare detectors, and it seems likely the Maxon unit will be in one of these evaluations sometime soon. This will allow Maxon to earn whatever reputation it deserves. Escort has earned its reputation by winning independent tests year after year, and by satisfying over 1,000,000 customers.

Finally, since its inception Cincinnati Microwave has been committed to designing, manufacturing, marketing, and servicing state-of-the-art radar detectors, and we'll be doing just that long after most other firms have lost interest and gone on to importing the next off-shore produced electronics "gadget".

I hereby grant you permission to use this letter in any way you see fit, provided it is reproduced in its entirety.

Sincerely,

Paul M. Allen
Sr. VP Mkting

PMA/pc

And you'll have a very high level of protection. Maxon's Dual Conversion Scanning Superheterodyne circuitry combined with its ridge guide wideband horn internal antenna, really ferrets out radar signals.



By the way Escort, we'll be happy to have our test around a bend in the road or over a hill. Maxon's detector really picks up 'ambush type' radar signals.

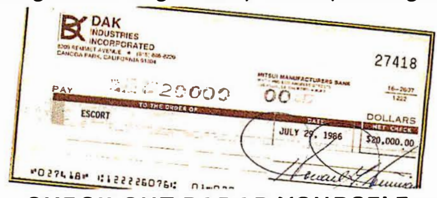
And the key word is 'radar', not trash signals. The 4 test check system that operates in 1/4 second gives you extremely high protection from signals from other detectors, intrusion systems and garage door openers.

So, when the lights and X or K band sounds explode into action, take care, there's very likely police radar nearby. You'll have full volume control, and a City/Highway button reduces the less important X band reception in the city.

Maxon's long range detector comes complete with a visor clip, hook and loop dash board mounting, and the power cord cigarette adaptor.

It's much smaller than Escort at just 3½" Wide, 4¾" deep and 1½" high. It's backed by Maxon's standard limited warranty. Note from Drew: 1) Use of radar detectors is illegal in some states.

2) Speeding is dangerous. Use this detector to help keep you safe when you forget, not to get away with speeding.



CHECK OUT RADAR YOURSELF RISK FREE

Put this detector on your visor. When it sounds, look around for the police. There's a good chance you'll be saving money in fines and higher insurance rates. And, if you slow down, you may even save lives.

If you aren't 100% satisfied, simply return it in its original box within 30 days for a courteous refund.

To get your Maxon, Dual Superheterodyne, Anti-Falsing Radar Detector risk free with your credit card, call toll free or send your check for just $99⁹⁰ ($4 P&H). Order No. 4407. CA res add tax.

OK Escort, it's up to you. We've got $20,000 (10) that says you can't beat Maxon on the road. Your answer, please?

Escort and Passport are registered trademarks of Cincinnati Microwave.

SO, WHAT'S DUAL SUPERHETERODYNE?

Ok, so far we've set up the conflict. Now let me tell you about the new dual superheterodyne technology that lets Maxon leap ahead of the pack.

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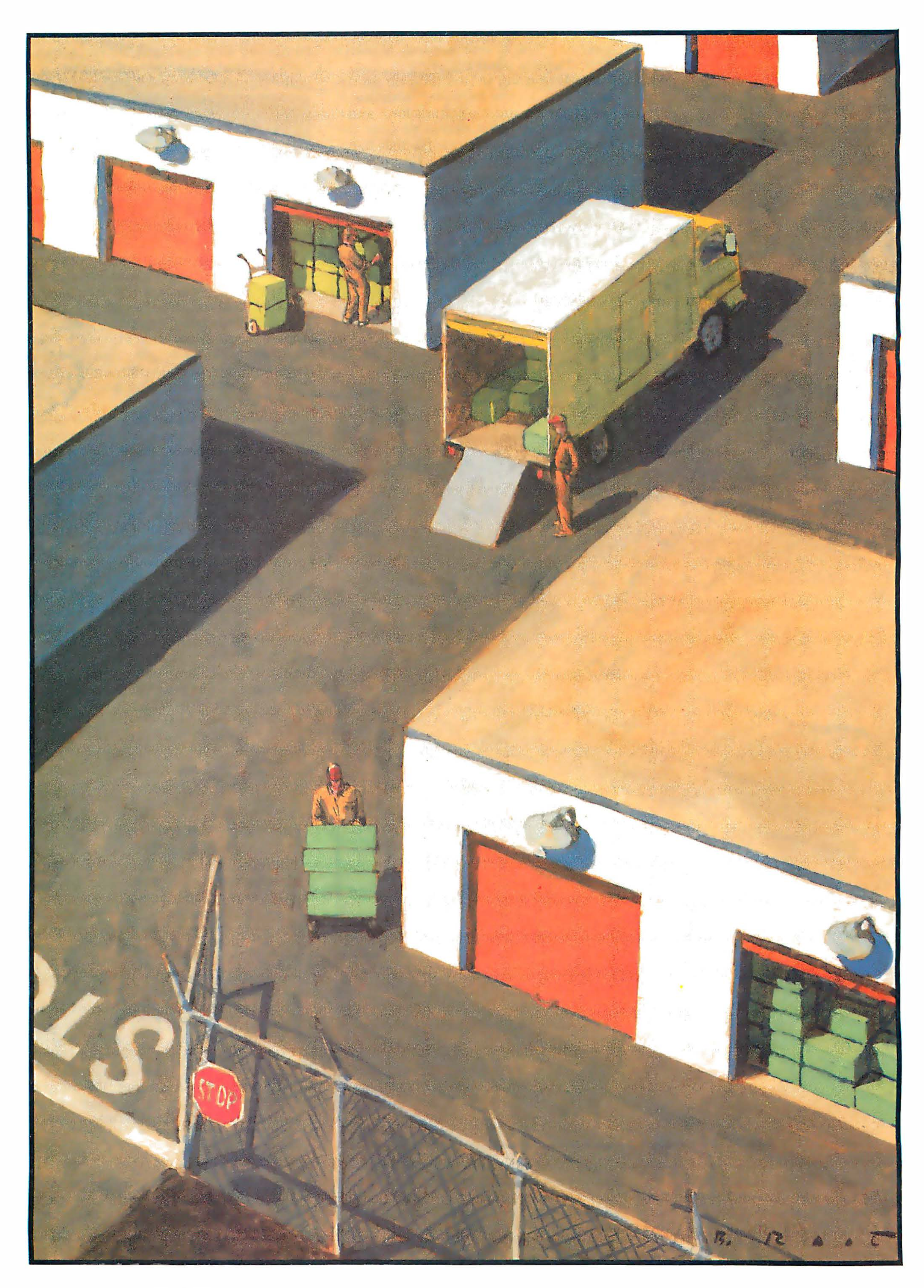
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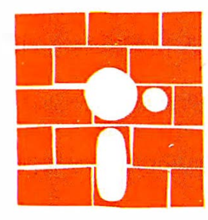
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STOP
STO

SAFE STORAGE ALLOCATION

BY JONATHAN AMSTERDAM

How to avoid the dangers of allocating memory



The term "storage allocator" is an instructive misnomer, for the complexity of such a system lies not in allocating storage but in reclaiming it. If computer memories were arbitrarily large, storage allocation would be trivial. Because they aren't, the process can be complicated.

I will discuss four storage allocators. The first, the basic allocator, uses standard algorithms and is quite common, appearing in many implementations of programming languages that provide storage allocation, like Pascal, C, and Modula-2. The other three are all attempts to correct the problems of the first. [*Editor's note: The four allocators in Modula-2 source code, along with their driver programs, are available on disk, and on* BIX. *The filenames are as follows:* ALLOC.DOC (*a "read-me" file*), A1TEST.MOD, ALLOC1.MOD, ALLOC1.DEF, A2TEST.MOD, ALLOC2.MOD, ALLOC2.DEF, A3TEST.MOD, ALLOC3.MOD, ALLOC3.DEF, A4TEST.MOD, ALLOC4.MOD, ALLOC4.DEF, MYTERMIN. MOD, MYTERMIN.DEF, MACHINES.MOD, *and* MACHINES.DEF. *See the insert card after page* 320. *Listings are also available on* BYTEnet. *See page* 4.]

WHAT IS STORAGE ALLOCATION?

All useful programs need storage to go about their business. A program could not accomplish much if it didn't use variables, and variables occupy space in the computer's memory. Many programs can get by with a fixed amount of storage, an amount determined when the program is written and compiled. Most FORTRAN programs fit into this category. Other programs need to allocate storage while they are running but can get by with a stack-based allocation scheme like that provided by many high-level programming languages—for example, a Pascal program that contains procedures with local variables. Some programs, however, not only need to acquire additional storage while running but also cannot deallocate that storage in the last-in, first-out manner demanded by a stack. Furthermore, they may require many pieces of storage of different sizes.

For example, the SIMPL compiler I presented in the December 1985, January 1986, and February 1986 issues of BYTE ("A SIMPL Compiler," parts 1, 2, and 3) must allocate storage for parse trees and symbol table records. These objects must exist for long periods of time, across the execution of many procedures, and may be deallocated in an order different from that in

(continued)

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ILLUSTRATION BY BARRETT ROOT

which they were allocated. So a stack-based scheme is inadequate. Something more general is needed: a program that allows the allocation and deallocation of memory parcels of various sizes in any order. For the purposes of this article, such a program is called a storage allocator.

THE ABSTRACT STORAGE ALLOCATOR

A storage allocator is a program that manages a contiguous region of memory called the *heap*. It allocates arbitrarily sized, contiguous segments of the heap, called blocks, when asked to do so by other programs in need of storage. The storage allocator also allows these programs to deallocate, or free, blocks that they no longer need. To these basic facilities, I add the ability to examine and change any location inside an allocated block. If you call the minimal unit of storage a word, you can characterize a storage allocator in the abstract as comprising these four operations:

- allocate: takes the number of words to allocate as an argument and returns either a block of the appropriate size from the heap or an indication that no block that size is available.
- free: takes a block as an argument and returns it to the heap for reuse.
- getWord: takes a block and a number *n* as arguments and returns the *n*th word of the block. (By convention, the block's contents are numbered from 0 to one less than the size of the block.)
- setWord: takes a block, a number *n*, and a word *w* as arguments and sets the *n*th word of the block to *w*.

THE BASIC ALLOCATOR

The first allocator organizes the heap as a linked list of available blocks called the free list. When a program requests storage, the allocator searches the list for a large enough block. If it finds one, the allocator removes the block from the list and returns a pointer to it to the requesting program. If no available block is large enough, the allocator returns a NIL, or empty, pointer. When a program frees a previously allocated block, it is returned to the free list. This scheme, with minor variations, is used by many extant storage allocators.

For the scheme to work, each block must contain certain information. In my implementation, all blocks, whether free or allocated, contain a size field as their first word. The size is simply the number of words occupied by the block, not including the size field itself. So, for example, if a block has a size of six, it actually occupies seven words of memory. You can obtain the size of a block by calling the blockSize function, which takes a pointer to the block as its argument.

When a block is allocated, all of it except the size field is available for use through the setWord and getWord procedures. When a block is not allocated, part of its space is used to hold a pointer to the next free block in the free list. (If a block is the last one in the free list, its pointer is NIL.) The number of words occupied by this pointer is the smallest allowable block size you may have; any request for a smaller block will receive one of this size. In my implementation, the minimum block size is two words because Macintosh pointers are two words long (on other microcomputers, a pointer can fit in a single word). Hence, in my implementation, the smallest block actually occupies three words of memory: one for the size and two for the pointer.

Initially, the free list contains a single block, which constitutes the entire heap. As blocks are allocated, the initial free block is broken up; when allocated blocks are freed, they are added back onto the free list. When a program requests a block of storage, the allocator chooses one from the list to satisfy the request. If the block is just the right size, it is spliced out of the free list and returned to the program. However, if the block is larger than the amount of storage requested, it is split into two blocks: One is the requested size and is returned; the other is put on the free list.

The chosen block may be only slightly larger than the request. In particular, it may be small enough so that after splitting, the remaining portion is too small to form a block of its own. For instance, if a program requests 10 words and the chosen block has a size of 12, the block cannot be split, since the two words remaining are not enough to form a block. In this case, the allocator returns the entire chosen block.

There are several possible strategies for choosing a block of storage. In the best-fit strategy, the allocator searches the free list from beginning to end and chooses the block whose size comes closest to the request without being too small. While this scheme requires searching the entire free list, it seems likely to make a good choice. However, if the chosen blocks are often slightly larger than the requests, then many small blocks are left on the free list. The allocator may then be unable to satisfy a request, not because there isn't enough storage in the heap, but because the storage is distributed among many different blocks, each of which is too small. This is called fragmentation.

In an effort to reduce fragmentation, you might use the worst-fit strategy—choosing the largest block on the free list. Another strategy, called first-fit, chooses the first block on the list that is big enough to satisfy the request. And Donald Knuth has proposed a next-fit strategy, which is similar to first-fit except that on subsequent requests, the search for a suitable block resumes from where it left off during the prior request instead of starting again from the beginning of the free list (see reference 1).

A lot of experiments have been done to see which of these methods allocates blocks most rapidly and results in the least amount of memory fragmentation. And the consensus on which one to use is that it depends. It depends on the order of allocation and deallocation, the size of the blocks allocated, and goodness knows what else. One thing's for sure, though: J. Robson has shown that for any allocation scheme that does not move blocks around in the heap to reduce fragmentation, there exists a sequence of allocations that will result in a request being made that cannot be satisfied due to fragmentation (see reference 2). Even if the sequence

consists only of requests for one-word and two-word blocks, the allocator can fail when memory is only two-thirds full. So all the methods have the same worst-case behavior. (Moving blocks around in the heap is not feasible for the basic allocator because the program allocating storage may have pointers to the blocks.)

The conclusion I draw is this: Unless you have a particular application in mind and understand its allocation pattern well, it doesn't much matter which strategy you choose. I have chosen first-fit for my basic allocator, since it is the easiest strategy to implement and has the undeniable advantage that it cannot possibly take longer to allocate a block than best-fit or worst-fit.

To deallocate, or free, a block, you could simply add it to the front of the free list. The speed of this process is hard to beat—two machine instructions on many computers—but it has a disadvantage. If two blocks occupying adjacent regions of memory have been freed, you want to merge them into a single block to reduce fragmentation. If you add freed blocks to the front of the free list, there is no easy way of checking for adjacency without searching the entire free list. You can do it if you incorporate more information into each block, but each word used in bookkeeping is a word denied the user. My method sacrifices time for space.

I maintain the free list in order of increasing addresses, so that the first block on the free list has the lowest address of any free block. When a program frees a block, the allocator traverses the free list until it finds the right spot for insertion. It is easy to check for adjacency now because the only candidates are those blocks on the list immediately before and after the insertion point. Using the size fields of the blocks and their addresses, it is easy to calculate if block boundaries coincide and the blocks can be merged.

The algorithm for this method is summarized in the text box "Algorithm for the Basic Allocator" above. The scheme is simple to implement, versatile, and has a minimum of overhead. But I come to bury the basic allocator, not to praise it, for it has a serious flaw. The problem is the well-known dangling reference. For example, let's allocate a block and copy its pointer,

```
newPtr := allocate(10);
copiedPtr := newPtr;
```

and then free the block by using free (newPtr). Even if the free procedure invalidates newPtr (by setting it to NIL, perhaps), copiedPtr still points to the freed block. It is possible for the program to use copiedPtr to access a deallocated block. You can avoid this by providing a bit in each block indicating whether or not it is free and by modifying getWord and setWord so that they detect accesses to a freed block and signal an error. But the real trouble occurs when the block is reallocated. Then copiedPtr can do some real damage, by changing portions of a block it shouldn't be pointing to, a block that may even belong to a different application.

I take this dangling reference problem very seriously. Many programmers think it is a minor nuisance that must be endured for efficiency's sake. I disagree. I expect programming languages to do their utmost to protect me from myself—from the many stupid errors I am bound to commit when I program. Modern programming languages like Modula-2 have gone a long way in this direction, but storage allocation is still an area where they provide more than

(continued)

ALGORITHM FOR THE BASIC ALLOCATOR

Initially: set the free list to point to a block consisting of the entire heap.

allocate: takes as argument the number of words to allocate; returns a pointer to a block with at least that many words if it can find one; returns NIL if it fails.
Begin
  If there are no blocks big enough to satisfy the request, fail.
  Otherwise, choose the first block *b* big enough to satisfy the request.
    If the block is big enough to split, then
      split the block into two parts: *c* with the requested number of words and *d* with the remainder; put *d* on the free list, and return *c*.
    Otherwise, remove *b* from the free list and return it.
End.

free: takes a pointer to a block *f* as argument.
Begin
  Search the free list from the beginning until reaching a block *b* whose address is larger than the one being freed. Let *a* be the block ahead of *b* on the free list.
  Put *f* onto the free list between *a* and *b*.
  If *f* and *b* are adjacent, merge them into a single block.
  If *f* and *a* are adjacent, merge them into a single block.
End.

getWord: takes a pointer to a block *b* and an offset *n* as arguments; returns the *n*th word of *b*, starting from 0.
Begin
  If *n* < 0 or *n* > size of *b*, then error.
  Otherwise, add *n* to the address of *b* to index the *n*th word, and return the word.
End.

setWord: takes a pointer to a block *b*, an offset *n*, and a word *w* as arguments.
Begin
  If *n* < 0 or *n* > size of *b*, then error.
  Otherwise, add *n* to the address of *b* to index the *n*th word, and store *w* in the word.
End.

enough rope to hang yourself. The rest of the article examines ways to shorten the rope.

THE TOMBSTONE ALLOCATOR

One solution to the dangling reference problem is never to reallocate a block once you have freed it. This is a little extreme, but a related solution might be worth exploring. When a block is freed, return all but its first word to the free list. Put a special value in the first word so that getWord and setWord can recognize it if an illegal access is made. I call these one-word markers *tombstones*. Tombstones are never freed; they are always there, ready to catch references to blocks that no longer exist.

You can easily modify the basic allocator to use tombstones. When a block is freed, you put all but its first word—the one containing the block's size—on the free list. Then you set the first word to zero. When getWord and setWord are called, they check the block's size field and signal an error if it is zero.

The tombstone scheme is simple to implement, but it too has a serious fragmentation problem. Each tombstone is an unreclaimable piece of storage in the middle of the heap. Adjacent freed blocks, which might have been merged by the basic allocator, can't be merged because of the intervening tombstones. You end up littering the heap with tombstones.

THE INDIRECT APPROACH

The dangling reference problem arises in the first place because several copies of a block's pointer may exist. You could avoid the problem altogether if you could ensure that only one pointer to a block would ever exist. It's unreasonable to demand that pointers never be copied, and you couldn't enforce it anyway, but there *is* another way. When a program makes a request for a new block, the storage allocator allocates both the block and a pointer to it, called the master pointer. The allocator then returns a pointer to the master pointer, or a *handle*, rather than a pointer to the block itself.

Adding this extra level of indirection goes a long way toward solving the dangling reference problem. You can make as many copies of the handle as you want, but all references to the block go through the master pointer. When a block is freed, the allocator adds it to the free list and sets its master pointer to a special value, say NIL. The allocator can then catch any subsequent references to that block. When the block is reallocated, a new master pointer is used. The technique is reminiscent of tombstones, but with one important difference: Master pointers need not be allocated in the middle of the heap. In my implementation, I start allocating master pointers from the top of the heap, and I try to confine them to a contiguous region. Blocks, meanwhile, are allocated from the bottom. The severe fragmentation problem of tombstones does not arise.

If this were the only benefit of double indirection, as the method is sometimes called, it would be worth implementing. However, since the storage allocator knows about all the pointers into the heap—the master pointers—it can play a couple of other useful roles as well. For one thing, the allocator can enable you to change a block's size, making it grow or shrink as you wish. To do this, the allocator allocates a new block of the desired size, copies the contents of the old block into it, and changes the master pointer to point to the new one. Any handles now reference the new block, and the original block appears to have magically changed its size.

More important, the allocator can perform compaction of the heap. Because it has the only direct access to the master pointers, the allocator is free to move blocks around in the heap. In particular, it can implement the following simple algorithm: First, find the allocated block with the lowest address (easily determined by scanning the list of master pointers). Copy the contents of this block to the bottom of the heap and update its master pointer to point to the new location. Then find the second-lowest block in the heap and move it to just after the first block. Do the same for all the allocated blocks. The result is a heap free of fragmentation with the allocated blocks at the low end, the master pointers at the high end, and the middle free. Figure 1 shows before and after pictures of a compacted heap. If you want, you can compact

(continued)

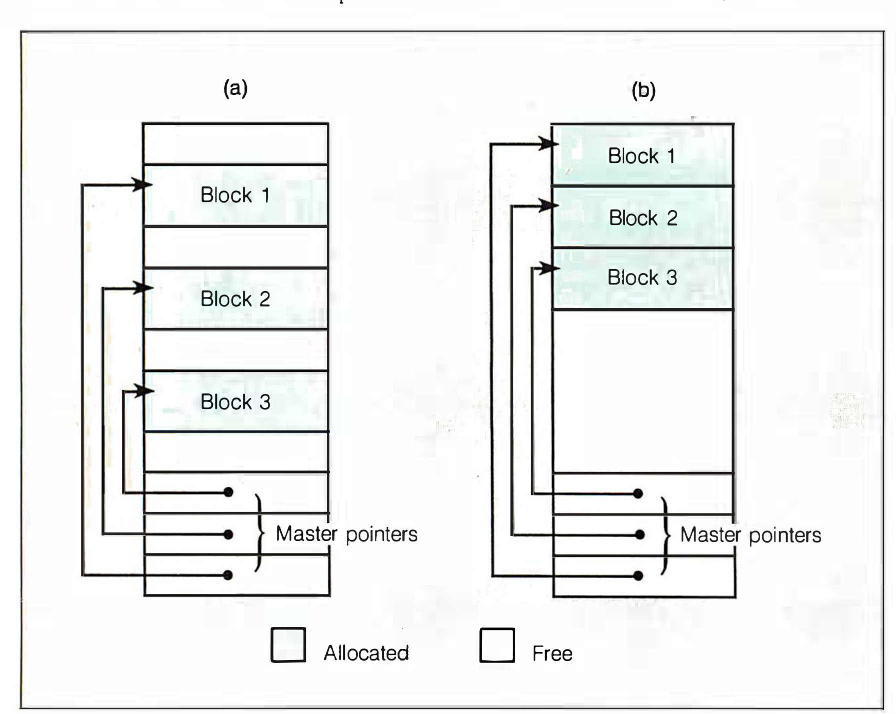


Figure 1: *Compacting the heap: (a) shows the heap before compaction; (b) after compaction.*

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ALGORITHM FOR THE DOUBLE-INDIRECTION ALLOCATOR

Initially: Set aside room at the top of the heap for master pointers. Set the free list to point to a block consisting of the rest of the heap.

allocate:
Begin
  Allocate a master pointer *m*, getting a handle to it, *h*. If no master pointer can be allocated, fail.
  Allocate a block *b* as in the basic allocator. If none is found, compact heap, and try again. If there is still not enough room, fail.
  Set *m* to point to *b* and return *h*.
End.

allocate master pointer: returns a handle (a pointer to a master pointer).
Begin
  If there is room in the master pointer area, allocate space for another master pointer, and return a pointer to it.
  Otherwise, compact the heap.
  If there is now room to extend the master pointer area, then extend it, allocate a master pointer, and return a pointer to it.
  If there is no room left, fail.
End.

compact:
Begin
  Let *l* be the bottom of the heap.
  While there is an allocated block that is higher in the heap than *l*:
    copy the lowest such block, *b*, to *l*;
    update *b*'s master pointer to point to *l*;
    set *l* to the address just after *b*.
  Set the free list to point to the remaining free space.
End.

free: takes a handle as argument.
Begin
  Let *m* be the master pointer that the handle points to.
  Free the block that *m* points to as in the basic allocator.
  Set *m* to NIL.
End.

resize: takes a handle *h* and a new size *n* as arguments.
Begin
  Allocate a block *b* of size *n* as in the basic allocator. If none is found, do nothing.
  If a block *b* is found, then
    let *m* be the master pointer that *h* points to;
    copy the block pointed to by *m* into the new block *b*;
    set *m* to point to *b*.
End.

getWord, setWord: as in the basic allocator, but take a handle instead of a pointer.
Begin
  If the master pointer that the handle points to is NIL, then error.
  Otherwise, access the block as in the basic allocator, using the master pointer.
End.

the heap every time a block is freed, thereby making a free list unnecessary. But since compaction can be expensive, it is probably better to use the free-list method, saving compaction for the time when a storage request can't be filled.

The algorithm for this method is shown in the text box "Algorithm for the Double-Indirection Allocator" above. Macintosh programmers will recognize the scheme as a subset of the Macintosh memory manager. The Macintosh allocator allows reuse of master pointers, though, so it's not as safe as this one.

There are two problems with my implementation of the double-indirection technique. The first is implicit in the name: An extra indirection (memory reference) must be performed for every access to a block. Furthermore, getWord and setWord have to check for a NIL master pointer on every access. You could do away with this check, but then an attempt to dereference the NIL pointer will make the program crash. If the allocator checks explicitly, it can die gracefully and provide information about the error, but even an uninformative crash is better than no check at all. Another way to reduce the overhead of double indirection is to hand out pointers to the blocks themselves, rather than to master pointers, if specifically requested to do so. This feature should be used only where speed is of the utmost importance, and you should check carefully to be sure that no invalid copies of this direct pointer are created. If there is a chance that the allocator will perform a compaction while the pointer is in a programmer's hands, then the allocator must provide a facility for locking a block in place so that it is not moved during a compaction. Providing direct pointers to blocks compromises the safety of the allocator, so I don't recommend it unless the application truly requires it.

The second problem with my double-indirection scheme is more serious. You can't reclaim a master pointer; once it's allocated, it's there for good. It can't even be reused. So every new allocation decreases the heap size by the length of one pointer. The list of master pointers will march relentlessly from the top of the heap to the bottom, bringing the allocator to a suffocating halt.

THE CAPABILITY-BASED ALLOCATOR

My fourth and final allocator attempts to get around the problem of nonre-

(continued)



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Algorithm for the Capability-based Allocator

Initially: Set aside room at the top of the heap for master pointers. Set the free list of point to a block consisting of the rest of the heap. Set the master pointer free list to NIL.

allocate: returns a capability *c*.
Begin
Allocate a master pointer *m*, getting a handle *h*. If none is found, fail.
Allocate a block *b* as in the basic allocator. If none is found, compact the heap and try again. If there is still not enough room, fail.
Set *m* to point to *b*. Set *c*'s handle to *h*. Set *c*'s generation count to *m*'s generation count.
Return *c*.
End.

allocate master pointer: returns a handle (a pointer to a master pointer).
Begin
If the master pointer free list is not empty (NIL), remove the first master pointer on the list and return it.
If the master pointer area has room, allocate space for another master pointer, set its generation count to zero, and return a pointer to it.
Otherwise, compact the heap.
If there is now room to extend the master pointer list, then extend the list, allocate a master pointer, set its generation count to zero, and return a pointer to it.
If there is no room left, fail.
End.

compact: as in the double-indirection allocator.

free: takes a capability as argument.
Begin
If the generation count of the capability does not equal that of the master pointer that the capability points to, then error.
Otherwise, free the block as in the basic allocator; increment the master pointer's generation count; add the master pointer to the master pointer free list.
End.

resize: as in the double-indirection allocator, but takes a capability instead of a handle.
Begin
If the generation count of the capability does not equal that of the master pointer that the capability points to, then error.
Otherwise, proceed as in the double-indirection allocator.
End.

getWord, setWord: as in the basic allocator, but take a capability instead of a pointer.
Begin
If the generation count of the capability does not equal that of the master pointer that the capability points to, then error.
Otherwise, access the block as in the basic allocator, using the master pointer.
End.

usable master pointers. It uses double indirection, but instead of providing a handle to a block, it returns a *capability*. A capability uniquely identifies the block; no two blocks ever have the same capability, not even if they occupy the same part of memory. When a block is allocated, a unique capability is associated with it. When the block is freed, the capability becomes invalid. Any block subsequently allocated, even if it comprises memory from the old block, will have a different capability.

A capability consists of a handle and a nonnegative integer that is a generation count. Each master pointer has its own generation count. When a new master pointer is allocated, its generation count is zero. When a block is allocated and associated with a master pointer, a capability is returned to the requesting program. That capability consists of a handle and the master pointer's generation count. When the allocator frees a block, it increments the generation count of that block's master pointer. When getWord or setWord accesses a block, it checks the generation count of the capability against that of the master pointer. If they are not the same, access is denied. The algorithm for this process is shown in the text box "Algorithm for the Capability-based Allocator" above.

In addition to the advantages of the double-indirection scheme, the capability-based method allows reuse of master pointers. When a block is freed, its master pointer can be linked into a second free list that is used for master pointers only. There is nothing to worry about when you reuse the master pointer because the safety checks are performed with the generation count, not with the value of the pointer.

When the generation count approaches an overflow condition, the simplest thing to do is to abandon the master pointer just before the overflow happens. When the allocator frees a block, it increments the master pointer's generation count, but if the new value is the largest possible value for the counter, the allocator does not link the master pointer into its free list. This pointer will never be reused, but the generation count will still work to prevent access. The space occupied by the abandoned master pointer is wasted, but overflow should be a rare occurrence if you provide a large enough generation counter. I provide 16 bits, which makes overflow very unlikely unless the allocating program runs for days on end.

You may wonder if you can implement the capability scheme with only a single indirection. Why not let a capability contain a pointer to the block, instead of a pointer to a master pointer? The problem then becomes where to put the block's generation count. You can't put it with the block, because it must remain even when the block is freed; you would have a variant of the tombstone allocator in which the merging of adjacent blocks is impossible. If you put the generation count somewhere else, you would basically have a second level of indirection. This might work, but I don't see how it would be superior to the capability scheme described here.

A minor implementation problem arises that illustrates an important technique. A capability is larger than a pointer: It is in fact a pointer plus an integer. An object that large is inconvenient to manipulate in most programming languages; for instance, you can't return it from a function. A more serious problem arises in a Modula-2 implementation that does not export the representation of capabilities. This *opaque export* of types, as it is called, is what you want, since to export the capability's data type is to allow other programs to manipulate it. But the catch is that in Modula-2, an opaque type can be no larger than a pointer. How can you store a pointer and an integer in the space for just a pointer?

My solution is to replace the pointer part of the capability with an offset, in words, from the start of the list of master pointers. Since Macintosh pointers are a hefty 32 bits, I can squeeze a 16-bit integer—the generation count—and a 16-bit word offset into a single pointer-size area. If your pointers are only 16 bits long, you'll have to economize more: perhaps an 8-bit generation count and an 8-bit offset. You can even do better than a word offset if you are willing to perform a multiplication on each access: Since all master pointers are the same size and they are allocated contiguously, you can treat the list of master pointers as an array. An offset of n can then be used to pick out the nth master pointer, just like an array index. If the size of a master pointer is s, then the nth master pointer is $s \times n$ words away from the start of the master pointer list (assuming $n = 0$ for the first master pointer). The word-offset trick can also be used to shorten the master pointers: Instead of containing a pointer to a block, a master pointer could contain an offset from the beginning of the heap.

While the capability scheme provides the ability to reuse master pointers, it is not ideal. For one thing, you still can't reclaim master pointers. If the allocating program allocates 100 blocks without freeing any, then it must create 100 master pointers. If the program then frees 95 of the blocks, there are still 100 master pointers, and there always will be. The capability scheme also takes a lot of time. There is no getting around doing a comparison on each access of a block, unless you resort to the risky expedient of handing out pointers to blocks. (It is possible to provide facilities for accessing several words of a block with a single check, but in most programming languages these can't be made very general.) Finally, the generation counts themselves occupy space that could be used for other purposes.

Although we have been coming closer and closer to a safe storage allocator, none of these approaches is perfect. All but the first of the allocators are safe, but at a price: slow access, in some cases severe fragmentation, and in all cases the inability to reclaim certain parts of the heap (tombstones or master pointers). There is also another problem: *leakage*. If the program allocates a block and then loses all references to it, that block can never be freed. If this happens frequently, available storage leaks away until the program crashes, its memory source exhausted.

Implementing the accessing procedures in hardware would solve the speed problem, but the others won't go away so easily. If the storage allocator is implemented as a subprogram, or module, in a high-level language such as Modula-2, you can't do anything about leakage or about reclaiming tombstones or master pointers. Since the storage allocator doesn't have access to the internals

(continued)

of the programs that invoke it, it cannot know when a block no longer has active pointers. Moreover, the allocator must always protect against attempted access by invalid pointers or handles. Thus, it needs some memory to note the invalidity of a particular pointer or handle value. Perhaps you could reduce the memory set aside to one bit per pointer, but I very much doubt it; in any case, there must be some memory usage.

However, if the storage allocator *does* know about the internals of programs that invoke it—in other words, if the allocator is an integral part of the implementation of the programming language—then you can do something.

Garbage Collection

A storage allocator that has access to the constants, global variables, and stack of the program using it need not fear invalid pointers. It can periodically search the program's storage areas looking for invalid pointers and destroy them, allowing reclamation of tombstones or master pointers. And if it finds no references to a particular block, the allocator can free it. So leakage ceases to be a problem as well.

A storage allocator that frees storage without user intervention is called a *garbage collector*. It is possible to get by with garbage collection and nothing else. In other words, you can allocate storage but not deallocate it, leaving that job to the garbage collector. (LISP uses this solution.)

Garbage collectors eliminate the problems of dangling references and leaks and are even safer than the safe allocators for two reasons. First, while safe allocators can catch an illegal access and halt a program gracefully, an illegal access can't even happen with garbage collection because the garbage collector won't free a block unless there are no pointers to it. Second, it is usually possible, especially in systems programming languages like C and Modula-2, to subvert a safe allocator. For example, if you are using a double-indirection allocator, you can subvert it by dereferencing a handle only once, resulting in a pointer to a block. There is no ironclad way to prevent this subterfuge, and indeed, you may even want to provide pointers to blocks, because double indirection is slow. Garbage collectors can also be subverted, but it is more difficult and would only be done maliciously; there is no good reason to do it.

However, garbage collection also has its drawbacks. Unless you use special hardware to support it, the process itself can be slow (though references to blocks are not affected). Most garbage collectors cannot permit a user program to run while garbage collection is taking place, so noticeable pauses can occur when running a program that allocates a lot of memory. Garbage collectors can also be difficult to write and debug.

Conclusion

On a fast machine that can support it in hardware, garbage collection is definitely preferred. But on other machines, especially microcomputers, it is often desirable to let programs free storage as well. To compromise, you can use one of the safe allocators presented here and occasionally perform a garbage collection to reclaim the space occupied by tombstones or master pointers and to free storage that has leaked. In fact, the tombstone allocator looks very good in this light: It allows fast access to blocks (a single indirection), and its fragmentation problems are greatly ameliorated by the garbage collector.

Unfortunately, you can't implement garbage collection as an extension to an already existing implementation; you have to build it into the language you are implementing. So if you are thinking of designing a programming language, think about storage allocation right from the start. Don't be one of those designers who, much to the chagrin of safety-conscious programmers, have left storage allocation to be dealt with as an afterthought; who, in effect, have said: "See you later, allocator."

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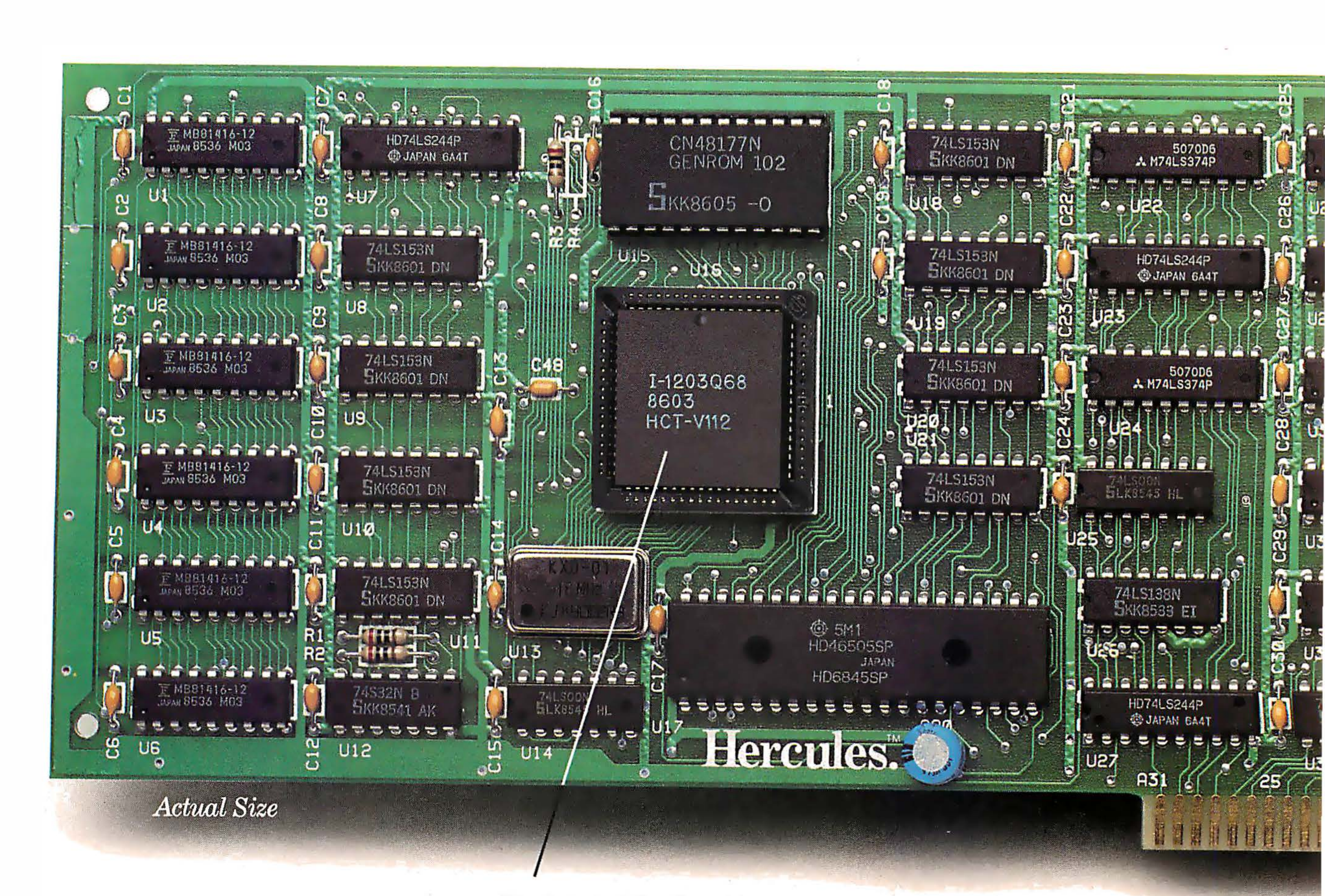
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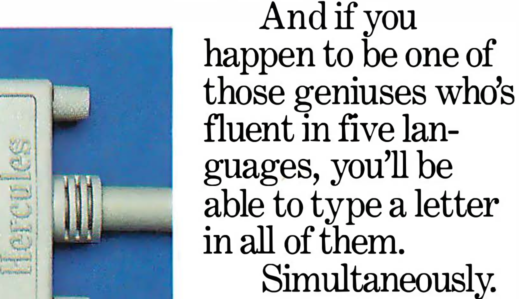
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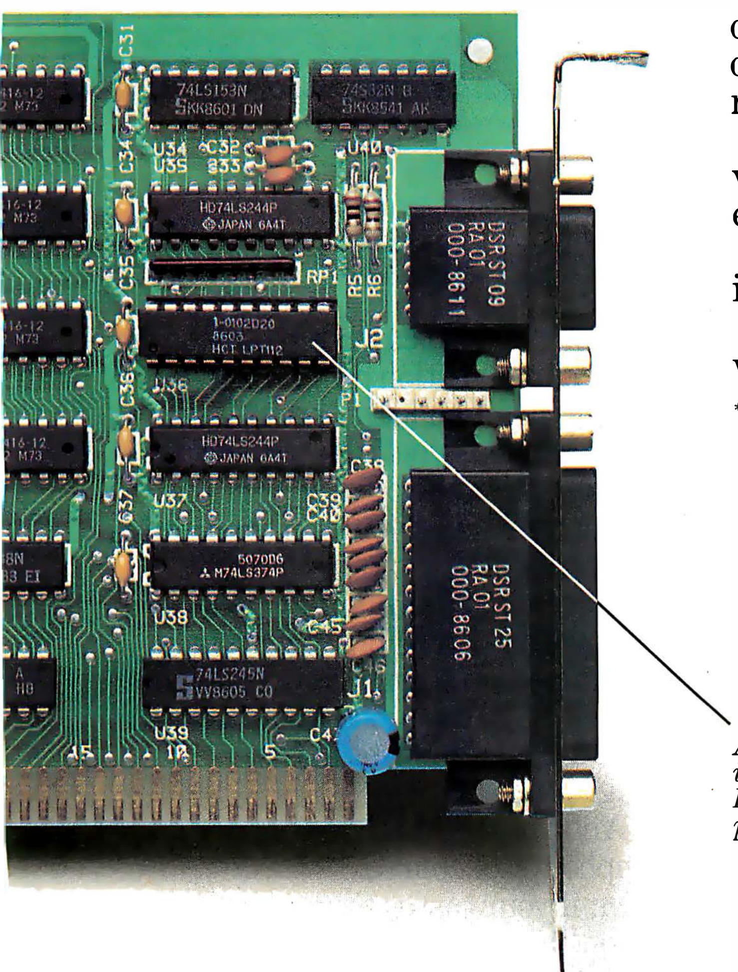
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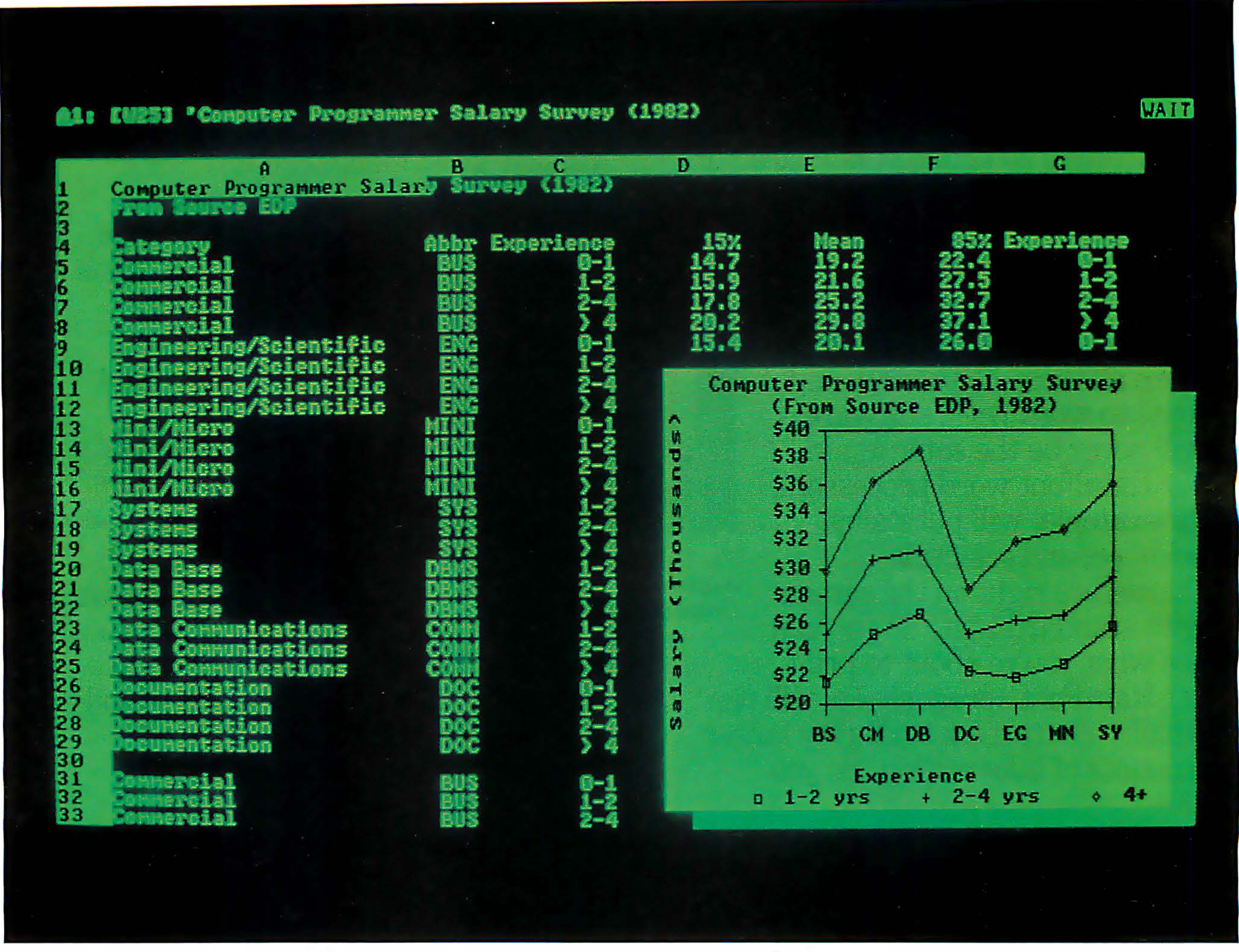
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Of course, if you want to talk about the world's favorite programs, you have to start with Lotus® 1-2-3.®

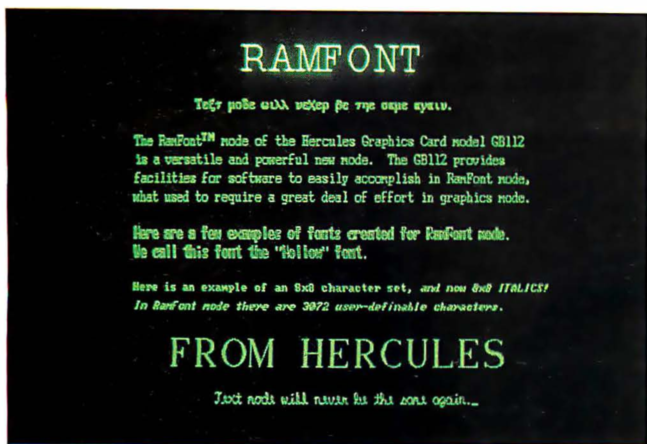
You won't recognize Release 2. Because now you can put nearly twice as much information on your screen, scrolling right and left and up and down at speeds you'll remember nostalgically from the days of Version 1A.

Another thing you won't recognize is that cute little graphics window. You can thank RamFont for that.

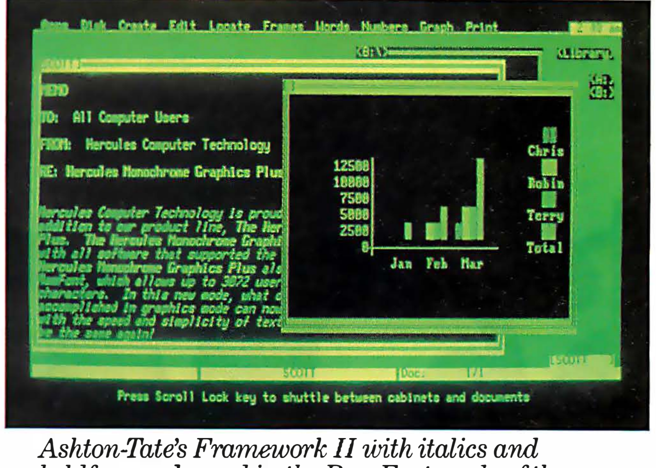
Now that RamFont is with us, you can pop up a graphics window any time you're in the mood and still keep your 1-2-3 spreadsheet in the background.

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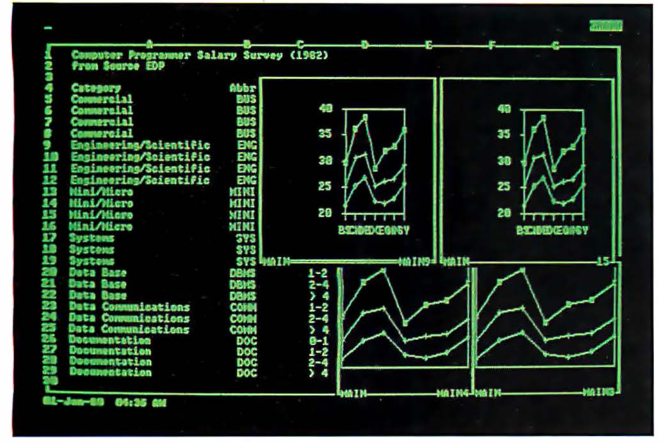
Or, if your tastes tend toward Ashton-Tate®'s Framework™ II, you'll be pleased to hear that you can really



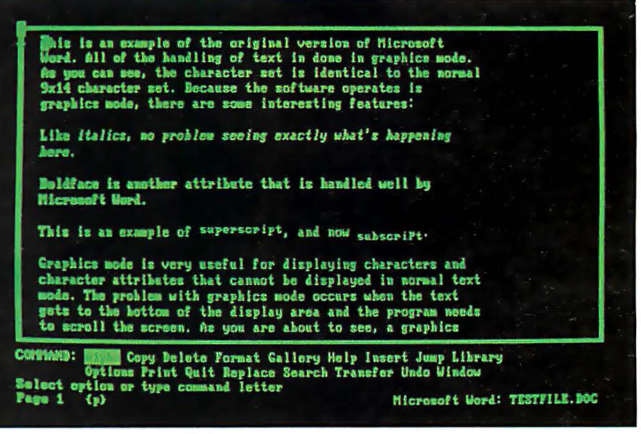
The Graphics Card Plus in RamFont mode showing multiple fonts created using FontMan,™ a Hercules program that comes free with each Card.



Ashton-Tate's Framework II with italics and boldface and speed in the RamFont mode of the new Hercules Graphics Card Plus.



The programmable RamFont is so flexible, Symphony can mix true text and graphics.



Microsoft Word in RamFont mode: italics, boldface and small caps—plus speed and lots of it, at last.

burn rubber with its word processor.

The revealed Word.

Speaking of word processors, remember a couple of pages ago how we said they would be forever changed? Well, the change has already begun.

For example, the Hercules Graphics Card Plus with RamFont makes Microsoft® Word a whole new program.

Suddenly the italics, boldface, superscripts and subscripts scroll superfast. Which means you don't have to twiddle your thumbs waiting for the screen to catch up with your fingers.

More to come.

As time goes by, more and more major programs will take advantage of the extraordinary capabilities of RamFont.

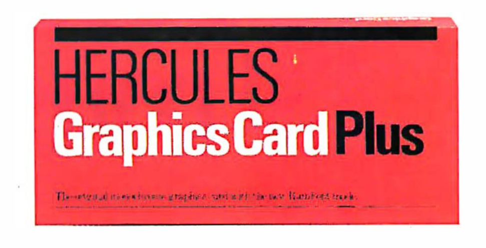
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You can buy a Hercules Graphics Card Plus and look forward to getting your socks knocked off.

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Just make sure you're sitting down.



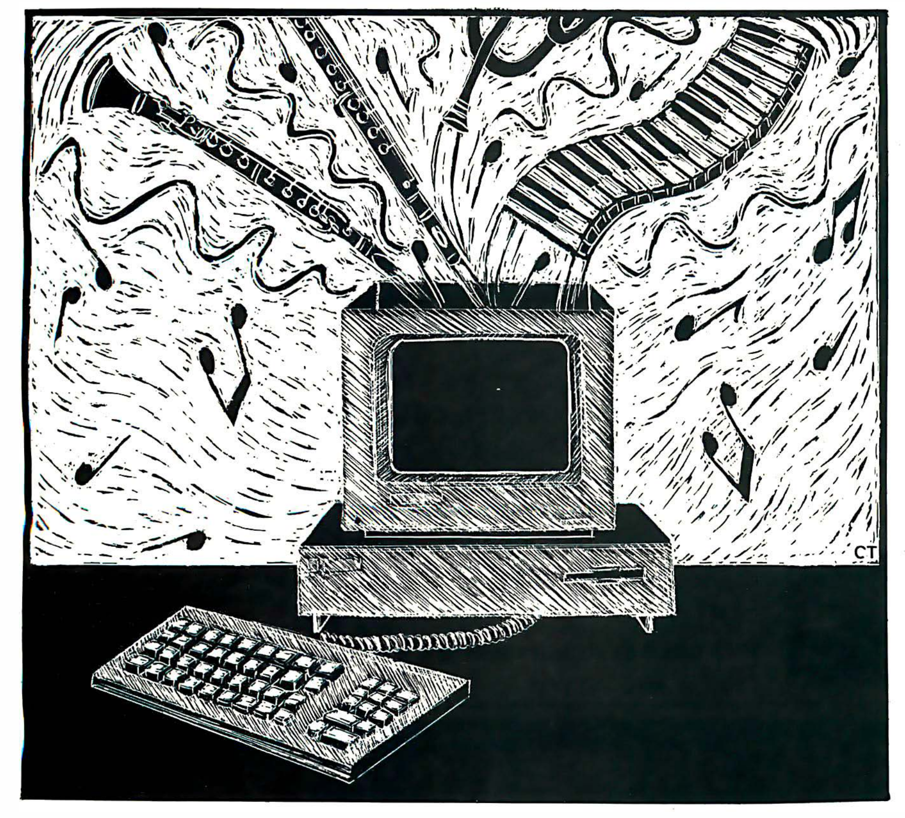
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BY DAVID D. THIEL

SOUND AND THE AMIGA

The amount of RAM available to the sound system provides the limit of what you can do

While the Amiga's sound-producing capabilities surpass the primitive square-wave sounds of early personal computers, the machine still has limitations to overcome. Making sound with microcomputers is sort of a trick. For example, when a microcomputer makes a clarinet sound, it actually produces a square wave. The result sounds like a clarinet because a clarinet's waveform is close to a square wave. But the waveform of a piano or a flute is more complex and can't be created easily with most microcomputers.



Sound data is a description of how you want to push air around with a transducer (speaker) so that the resulting fluctuations in air pressure are perceived by the ear as sounds. The amount of data involved in making complex, realistic sound events is tremendous. Consider the compact disk: 75 minutes of high-fidelity audio on a disk or 550 megabytes of 8-bit data; that's roughly 12K bytes of data per second. That much data can quickly swamp the capabilities of an 8-bit microcomputer.



HARDWARE-GENERATED SOUND

Before the advent of microcomputers, mainframe hackers had discovered that printing certain sequences of letters on a line printer would create certain pitched tones. Before long, enormous amounts of paper were being used to play Christmas carols.

The KIM-1, introduced in 1975, was not equipped to produce sound. But by 1976 hackers were connecting its hardware timer to an output bit at-

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ILLUSTRATION BY CLAUDIA TANTILLO

tached to a speaker. This simplified the sound data to a waveform that the hardware could make. This technique produces the square-wave sound found in digital watches and computers like the IBM PC. The advantages of this approach are its low cost and the minimal software and processor time you need to control a sound.

With a little more hardware, you can control the amplitude of the voltage swing from low to high and thus the amplitude, or volume, of the sound. The combination of a timer-based square-wave generator with amplitude hardware is the fundamental building block of the hardware-based sound generation found in microcomputers ranging in complexity from the Commodore VIC-20 to the Atari 520ST. A pseudorandom hardware bit generator can be added to produce nonperiodic sound information, commonly called noise.

There are several advantages to this type of hardware-based approach: You don't need to spend a lot on specialized hardware, little processor intervention is necessary, and you won't use large quantities of memory to store the sound data. However, there are also disadvantages: The sound has a computerlike quality, you have a fixed and limited number of channels, and you are limited to coarse amplitude and frequency resolution.

ANOTHER APPROACH

In 1980, I started creating sound with microcomputers in a different way. I was given a 6502 microprocessor, 128 bytes of RAM, 4K bytes of ROM, an 8-bit DAC (digital-to-analog converter), and the assignment to "make a sound that goes boing." I quickly learned a technique that acknowledges the periodic nature of sound—using algorithms, tables of sound data, or some combination of the two. This technique requires a DAC for the microprocessor whose output (after signal processing and amplification) you intend to hook up to a speaker. The number of bits in the DAC establishes the range of amplitudes and, to a degree, the complexity of the waveform.

This approach is used in its simplest form on the Apple II, which has a 1-bit DAC directly under software control. Even though the Apple II has only two levels of output, you can precisely control the time between pulses, which allows an amazing variety of sounds, music, even speech. However, while the microprocessor is producing sound data, there is little time for it to do anything else. Careful and meticulous interleaving of software tasks can give the appearance of two things happening at once, but this is time-consuming and not a generalized solution.

The Macintosh takes the DAC approach one step further by integrating sound production with video processing. While the monitor's video beam moves back to the left edge of the screen for each scan line, the Mac's sound hardware takes a byte out of a fixed-length buffer and outputs it to an 8-bit DAC. Since the microprocessor is freed from having to interleave the sound-generation task with other tasks, the effect is a stable sound-generation rate. However, the microprocessor still has to put sound data in the buffer ahead of the video beam for every frame (60 times a second).

There are trade-offs with the Macintosh's approach to sound. When the Mac creates four-voice sound, it uses about 50 percent of the microprocessor's throughput. This doesn't include waveform scaling for independent control of each voice's volume. Since graphics on the Mac are processor-intensive, it's difficult to create elaborate sound and graphics at the same time.

SAMPLING

You can also directly digitize sound from other sources, store it, and play it back through the DAC. This technique is called sampling, and it has the best potential for reproducing

complex realistic sound with a computer. Once you have sampled the sound data, you can process it further for special effects, splice it, loop it, and set it up for random access.

One problem with sampling is the amount of sound data you need. The Mac's sampling rate, for example, is 22,300 samples (bytes of data) per second. For this reason, sampling has been used very little on the 128K-byte Mac.

Sampling also has the special problem of trying to produce realistic sound by pumping numbers through a DAC. You can get audio-aliasing distortion, or the "sonic jaggies" (the sonic equivalent of the jagged lines you get when you draw angled or curved lines on a raster display). You can get false harmonics if you use too slow a sampling period to reproduce sound of a given frequency.

THE AMIGA

The Commodore Amiga offers an enhanced, hardware-assisted, DAC approach to sound. It has more than four times as much sound hardware as the Mac. Each channel is composed of an 8-bit DAC with 5 bits of amplitude control, and the microprocessor can output sound data to each DAC independently.

The Amiga has a low-pass filter that cuts out most output with frequencies above 7 kHz. This eliminates the aliasing distortion that occurs above 7 kHz when sampling at 28,800 samples per second. While not high-fidelity, the sound is good for a personal computer. The usable sampling period in terms of the filter is 14,000 to 28,800 samples per second. This range can be used for one octave of musical notes reproduced faithfully up to 7 kHz. In actual practice the sampling rate can be as low as 7000 samples per second for some applications where waveform data space is at a premium.

The Amiga's hardware design philosophy is to leave the processor free as much as possible. The direct memory access (DMA) hardware for sound generation complies with this rule. The Amiga uses four variable-period DMA channels. You can vary the sampling rate from 28,800 samples per second to one sample every two seconds. These samples can be anywhere in a 512K-byte address space and can be as short as 2 bytes or as long as 256K bytes. The output of each DMA channel is processed by a low-pass filter that becomes effective at 4 kHz and cuts out sound frequencies greater than 7 kHz.

To generate sound on the Amiga, you must load the DMA hardware registers with the starting location of the sound data, its length, and the sampling period. When enabled, the Amiga generates sound until it gets to the end of the sound data; then it resets the location and length and repeats the process until it is disabled. This frees the processor from the majority of the work typically associated with audio sampling.

The Amiga has four times as much sound hardware as the Macintosh.

The DMA hardware retrieves each byte of the sound buffer sequentially. Since every byte in the wave table is pumped out, the length of the wave table determines the highest fundamental frequency that the channel can play. For example, to play the musical octave from A (at 440 kHz) to G# (at 830 kHz) without the distortion of aliasing, the waveform length must be 16 bytes. This is not a lot of resolution with which to describe a complex waveform. The waveform length for the next octave can only be 8 bytes, and so on. Therefore, reproducing the sound range of the upper half of the piano keyboard is subject to

(continued)

Substantial software exists to support the use of sound hardware in the Amiga's multitasking environment.

some compromise.

The DMA sound hardware also has the ability to seamlessly join waveform data together. When the audio DMA hardware reads its registers, it copies them into internal registers and an interrupt occurs. At this time you can change the data pointer and length so that when DMA starts the process again, it could be accessing a new and different piece of sampled data. This has many exciting ramifications. You can simulate a musical instrument's sound by sampling its attack and splicing that to its waveform. This saves a great deal of space and opens up a whole new world of hybrid instruments.

In addition, the Amiga has the first standard left and right stereo outputs in personal computer history. The four channels of DMA-driven sampling hardware are output through the low-pass filter and routed through fixed-assignment stereo jacks for connection to external audio equipment. By using two complementary channels, you can position sound in left-to-right space with software. Obviously, there is a trade-off between the number of discrete channels desired and the stereo spread, but it is a lot of fun to put explosion sounds together with their visual counterparts. If you are using a monaural monitor, attaching a Y-connector makes it possible to hear all four channels.

The Amiga's sound hardware also has the capability to modulate one channel's period and/or volume by the output of another's. You disable the modulating channel's audio output and then use its data to modify the modulated channel's frequency and/or amplitude. Used in its simplest form, this relieves the load on the processor for effects like tremolo (amplitude modulation) and vibrato (frequency modulation).

SOFTWARE SOUND SYNTHESIS

In 1973, Dr. John Chowning published a paper in the *Journal of the Audio Engineering Society* entitled "The Synthesis of Complex Audio Spectra by Means of Frequency Modulation." This FM model of sound synthesis has become the basis for several professional musical instruments, including the Yamaha DX-7. If you use channels to modulate other channels, the Amiga can achieve a variety of the synthesis models proposed by Dr. Chowning. While this mode uses up all of the Amiga's sound resources, it can create one very complex voice that rivals those of dedicated hardware synthesizers.

Substantial software exists to support the use of sound hardware in the Amiga's multitasking environment. Since many tasks can run concurrently—each assuming that it "owns" the machine—there needs to be a way of arbitrating who gets the sound hardware. Audio software support on the Amiga follows the same device model established for all peripherals on the system.

The Amiga allocates virtual audio channels on a priority basis and supports all of the above-mentioned hardware features. It also supports interrupt processing for waveform splicing with a queue that stores the sound requests for a particular channel until it can process them. While the audio device is flexible, it is complex to use. For certain types of sound synthesis, direct access to the hardware registers is more processor-efficient.

One sound innovation on the Amiga is its support of voice synthesis as a standard peripheral. Without any additional hardware, the narrator device does an understandable simulation of the human voice. The SoftVoice program, which is the heart of the narrator device, provides all the elements for phonetic speech generation. In addition, there is a text-to-phoneme program called Translator that you can use to create phonetic strings for input to the narrator device. The only costs for using speech as part of the man-machine interface are some RAM and some processor time.

RESOURCE LIMITATIONS

It is important to remember that sound is data to a computer. This is the key to using the Amiga to produce sound. You must make major trade-offs in space and processor utilization. Unfortunately, Commodore has marketed the Amiga as a 256K-byte machine. Full utilization of its sound and graphics hardware requires a lot of memory. A wave table for six octaves of a good string sound takes 32K bytes. If you wanted to have six different instruments available for random access in a music program, and if your program required 70K bytes, the waveform data and program together would need 262K bytes; in other words, they wouldn't fit.

In my experience in recreational software, the resources allocated to sound production are usually one-eighth of the total. In the coin-operated video-game world of Reactor and Q*Bert, the sound program required 4K bytes of EPROM compared to 32K bytes for the game computer. In a Commodore 64 program, 3K to 6K bytes were set aside in RAM for sound. If this ratio holds true, then the available RAM for sound samples and the sound system on the Amiga is 32K of its 256K bytes. These numbers do not take into account the Amiga's multitasking nature that makes the available RAM an indefinite concept. The point is, the amount of RAM available to the sound system provides the limit of what you can do with sound and the Amiga.

To overcome space limitations, you can use the Amiga's 68000 to create sound data "on the fly." This approach trades space for speed and is not usually acceptable unless you plan to dedicate the machine to sound production. The really exciting part of the Amiga's sound system is its hardware-assisted software-based approach. A DAC is to sound as a bit map is to graphics. A software approach is open-ended. Within processor and RAM limitations, you can do whatever you are clever enough to conceive. ■

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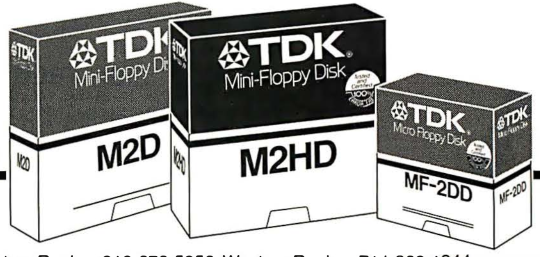
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Inquiry 179

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A USEFUL PROPERTY OF 2^n

BY ROBERT C. ARP JR.

Simplified flag testing and input comparison by exploiting powers of 2

WHILE WRITING FEDERAL tax programs for my HP-41CV calculator recently, I repeatedly needed more than the 11 available user flags. Because I have the Extended Functions/Memory Module (EF/MM), I considered a suggestion from the owner's manual to increase the number of *apparent* general flags by using the X< >F (X exchange flags) function.

For reasons I will discuss, I was not satisfied with the results. However, this exercise led me to observe a remarkable property of summations of 2^n.

I do not intend to offer a rigorous mathematical proof of the 2^n property; I have simply verified that the property functions within the limits of my calculator.

I have studied many math and computer books during my career, but I cannot recall ever having seen reference to this property. However, if there is someone to whom credit should be extended, then I apologize for the oversight.

THE PROBLEM

I had been designing a system of programs for federal taxes that would permit updating of totals in a spreadsheet fashion. Because of the required number of schedules and forms, I was using the status of flags to branch to labels in order to implement various options. The HP-41CV has 11 general-purpose flags. I needed more.

The EF/MM owner's manual suggests the use of X< >F to increase the number of apparent general-purpose flags. This is possible because executing this function sets the status of flags 0 through 7 according to a status code previously entered into the X register. Simultaneously, a code representing the former status of those flags is transferred from the F register to the X register. A numeric code for each of the eight flags is shown in table 1.

You set one or more of the flags, 0 through 7, by forming a sum of the numeric codes for each flag affected. For example, to set flags 1 and 2, you set the sum to 2+4=6. The sum 255 is required to set all flags; 0 is required to clear all flags. Flags whose numeric code is not an addend of the sum are cleared.

You can realize the apparent increase in available flags by calculating several summations and storing them in separate registers for later recall and comparison. In this manner, a combination of flag statuses is understood to represent the status of an apparent flag. For example, if the sum 6 were stored in a register, by recalling its contents and comparing it to the contents of the X register after an execution of X< >F, you could determine if and only if both flags 1 and 2 were set.

I felt that I could tolerate the clumsiness of the operation; however, I could not afford to devote one register for each of the required status codes. Memory in the HP-41CV is organized in registers of 7 bytes in size; most instructions require only 1 or 2 bytes. Of course, registers used for storage cannot be used for programming.

While reviewing the X< >F function, I had noticed that the numeric code for each flag n was 2^n. I am sure that it was this observation that prompted the lateral thinking required

(continued)

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for the unconscious formulation of a satisfactory method of generating any number of flags.

THE QUESTION

Because computers use the binary system and because powers of the base must certainly be associated with the system, I wondered if there was a property of 2^i that could be exploited to create an association between the presence or absence of a particular 2^n.

THE INVESTIGATION

After playing with numbers for a while, I made the following supposition: If a $\Sigma\ 2^i$ is divided by $X = 2^n$, and $X \leq \Sigma 2^i$, then the quotient will be odd when X is an addend of $\Sigma 2^i$ but will be even otherwise. If this is true, then quotient modulo 2 will be 1 or 0.

The example in figure 1 shows what happens when a $\Sigma 2^i$ is divided by an arbitrary 2^n. Suppose that the summation is composed of random addends that are each 2^n. If $n = 0, 3, 7$, then $\Sigma 2^i = 2^0+2^3+2^7 = 1+8+128 = 137$. Notice the quotients for the following divisions, where $\Sigma = 137$.

Note also that whenever 2^n is an addend of the summation, the integer portion of the quotient is odd. However, whenever 2^n is not an addend, the integer portion of the quotient is even (0 is considered to be even). Thus, performing modulo 2 on the integer portion yields a 1 when 2^n is an addend but yields a 0 otherwise.

Keeping in mind that n has remained positive throughout the example, these observations and conclusions may be summarized, as they are in figure 2.

At this point we have verified that there is an association between a summation of 2's and its addends that enables us to determine whether a particular 2^n is one of the addends. Furthermore, a mathematical calculation will produce a 1 if the test is true and a 0 if the test is false.

Table 1: *Numeric code for each of eight flags.*

Flag	0	1	2	3	4	5	6	7
Numeric Code	1	2	4	8	16	32	64	128

$$\frac{\Sigma}{2^0} = 137.000 \qquad \frac{\Sigma}{2^1} = 68.500 \qquad \frac{\Sigma}{2^2} = 34.250$$

$$\frac{\Sigma}{2^3} = 17.125 \qquad \frac{\Sigma}{2^4} = 8.563 \qquad \frac{\Sigma}{2^5} = 4.281$$

$$\frac{\Sigma}{2^6} = 2.141 \qquad \frac{\Sigma}{2^7} = 1.070 \qquad \frac{\Sigma}{2^8} = 0.535$$

Figure 1: *This example shows what happens when a $\Sigma 2^i$ is divided by an arbitrary 2^n.*

$$\left[\text{INT}\left(\frac{\Sigma 2^i}{2^n}\right)\right] \text{MOD } 2 = \begin{cases} 1, & 2^n \text{ an addend of } \Sigma 2^i \\ 0, & \text{otherwise} \end{cases}$$

Figure 2: *Keeping in mind that n is positive, these conclusions can be made.*

USAGE

The discovery of the association between a summation of 2's and its addends was only a beginning. Now I had to determine a method of setting, clearing, and testing the condition of flags that does not depend upon variable assignment limitations of the programming medium.

The following concept-level algorithms are limited only by the largest number that can be processed by the programming medium:

Setting a flag:
1. Input a flag number, n.
2. Compute $X = 2^n$.
3. Add X to $\Sigma 2^i$.

Clearing a flag:
1. Input a flag number, n.
2. Compute $X = 2^n$.
3. Subtract X from $\Sigma 2^i$.

Testing a flag condition:
1. Input a flag number, n.
2. Compute $X = 2^n$.
3. Recall $\Sigma 2^i$.
4. Compute $Y = \Sigma 2^i / X$.
5. Extract Z = integer portion of Y.
6. Compute state = Z modulo 2.

These concept-level algorithms represent minimum algorithms. Caution is required when setting and clearing flags because an erroneous sum would be accumulated whenever setting a flag more than once or whenever clearing a flag not previously set.

These minimum algorithms may be used in cases where attention is being paid to flag conditions during programming. Alternately, you may test the condition of a flag before setting or clearing. Exercising this caution alters the algorithms as shown below:

Set flag if clear:
1. Execute test-flag algorithm.
2. If state = 1, then end, else continue.

Clear flag if set:
1. Execute test-flag algorithm.
2. If state = 0, then end, else continue.

The three algorithms expect an in-

(continued)

To the user, n is a flag that must be set, cleared, or tested.

teger, *n*, as a passed parameter. To the user, *n* is a flag that must be set, cleared, or tested. Each algorithm raises 2 to the power of *n*. The set-flag algorithm accumulates 2^n as a component of a sum consisting of addends 2^i, where each *i* is a member of the set of all flags that you have set previously but not cleared. The clear-flag algorithm subtracts 2^n from $\Sigma 2^i$. The test-flag algorithm divides $\Sigma 2^i$ by 2^n, discards the quotient's fractional component, and uses remainder division to report the condition of flag *n*.

When executing the test-flag algorithm, there may be times when you want to test for $2^n \leq \Sigma 2^i$ before performing the division. When this condition is false, a 0 may be returned by the algorithm immediately. Furthermore, the subroutine is not restricted to the use of a single $\Sigma 2^i$. Any of several summations could be used depending upon the validity of some particular condition.

An added attraction of the process, whether it is useful or not, is the fact that all components 2^i of any $\Sigma 2^i$ may be extracted by processing each 2^n less than or equal to $\Sigma 2^i$ and noting those that produce a 1.

ADDITIONAL USES

I also discovered that in addition to solving my problem of inadequate flags, I was able to simplify an aggravating problem associated with the correctness of keyboard input and input-driven processing.

Like most other computers, the HP-41CV permits the programmer to process alphanumeric input by the detection of key codes. There are actually two sets of codes associated with HP-41CV keyboard inputs. One code represents the topographical location of keys; the other is an internal representation of character codes based on ASCII.

I had been executing certain options that depended on keyboard input, and I was using both of the key codes. In doing this, I had to verify the correctness of user choices and establish the numerous branching and subroutine calls. All of this was dependent upon the complexity of the tax system itself and upon unpredictable user selection. The test-flag algorithm immediately simplified the process.

In use, to prevent the summations of 2^i from growing too rapidly, I first converted the HP-41CV codes to something more palatable by subtracting a base number from particular inputs. For example, the ASCII equivalent codes for letters A through Z are numbers 65 through 90. After any alphabetic input, I simply subtracted 65 from the ASCII equivalent code for the input. This produced equivalent codes 0 through 25.

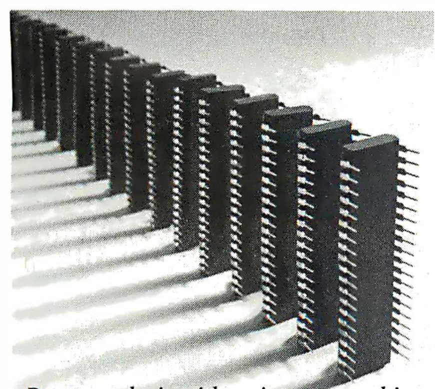
It is easy to see that $2^{25} = 33{,}554{,}432$, which is the largest possible 2^n with the modified code, is much less than $2^{90} = 1.238 \times 10^{27}$, which would have been the largest possible otherwise.

I then passed the resultant *n* to a keytest subroutine along with the required $\Sigma 2^i$, in which each *i* was a permissible code. I included a provision for detecting codes less than zero, because they were possible (the conversion uses subtraction) but illegal. All codes producing values of 2^n that were not addends of $\Sigma 2^i$ would then return a 0. In the calling program, a 0 would cause a branch to an error subroutine. This adaptation is shown below.

Keytest:
1. Input *n*.
2. If $n<0$, return a 0, else continue.
3. Compute $X = 2^n$.
4. Compute $Y = \Sigma 2^i/X$.
5. Extract Z = integer portion of Y.
6. Compute Z modulo 2.

Thereafter, this algorithm became a valuable programming tool, providing many simplifications that could not have been realized otherwise. Eventually, the input detection function became as important as the process for which I developed the original algorithm. ■

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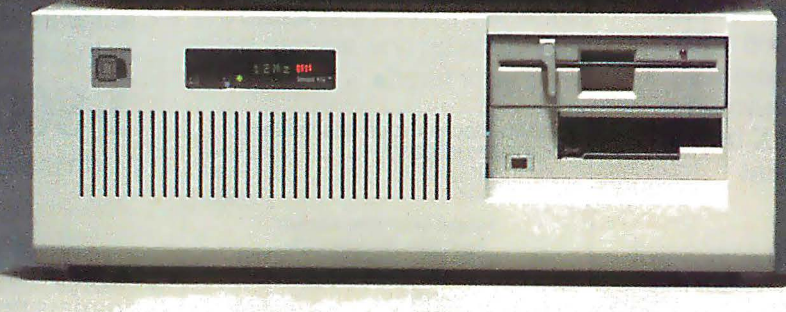
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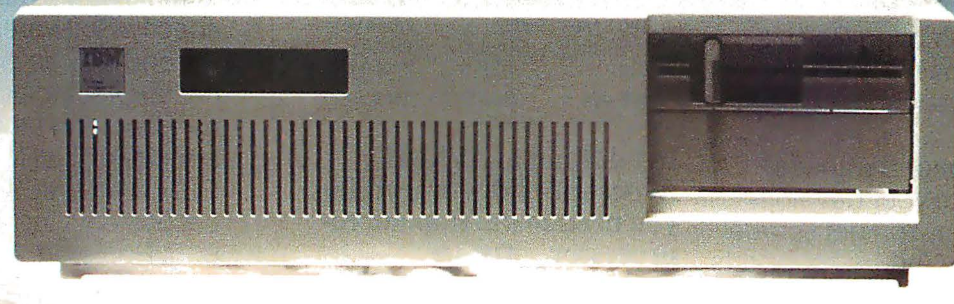
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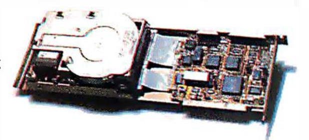


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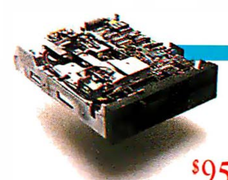


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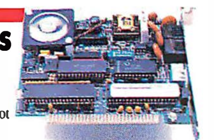
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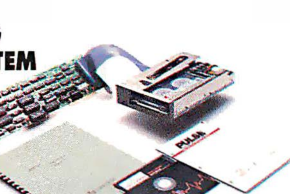
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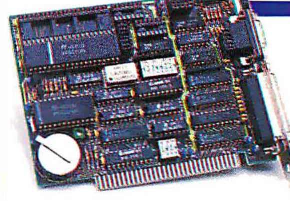
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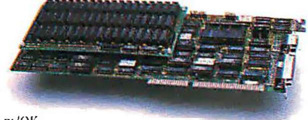


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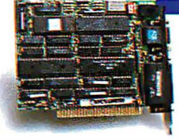
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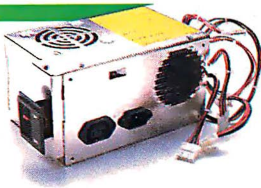
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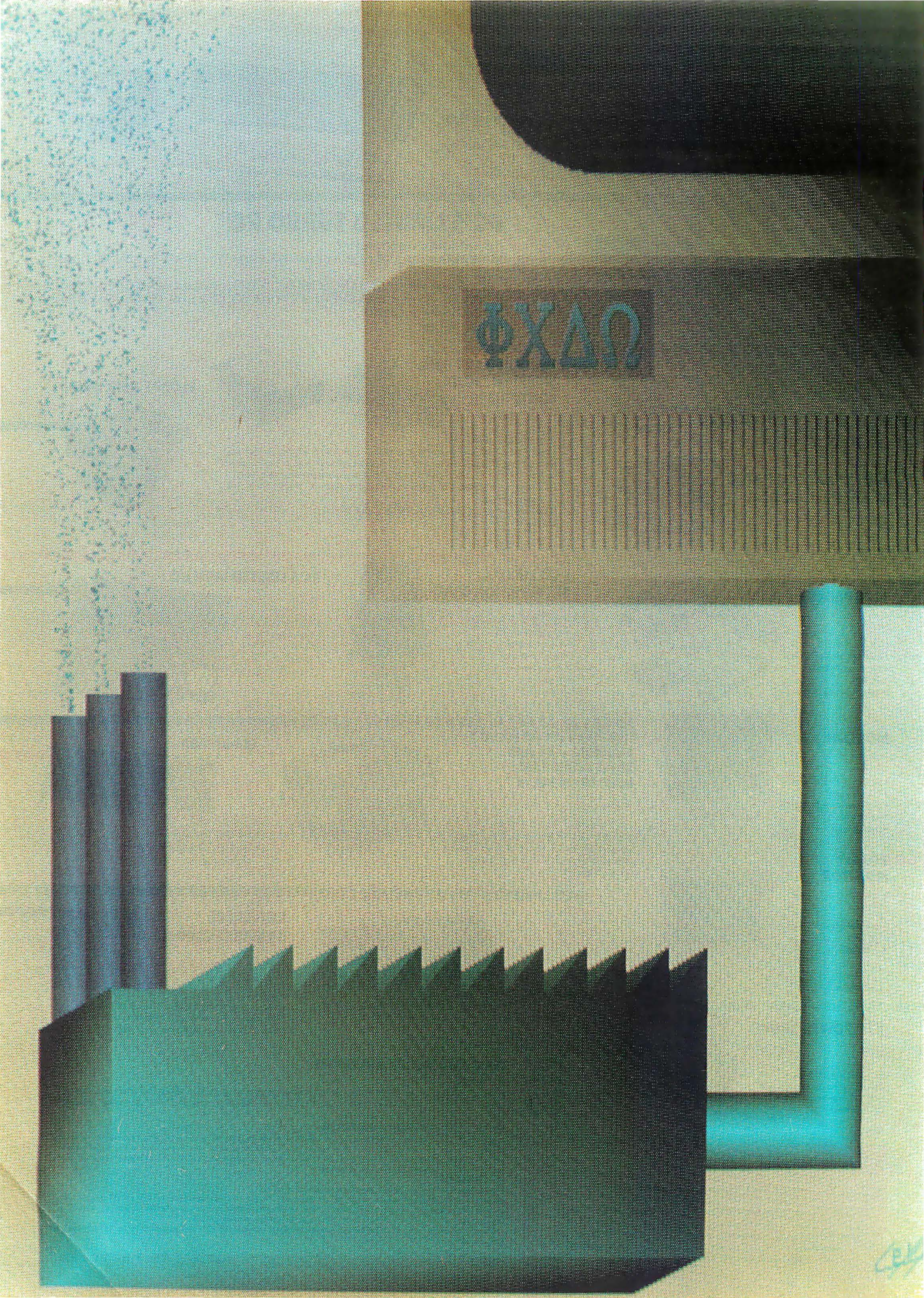
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Inquiry 231




ΦΧΔΩ

Public Domain Powerhouses

I BEGAN MY "RESEARCH" on this theme last December by placing a call for submissions in the Fixes and Updates section. Within weeks, readers submitted over a hundred programs. I have considerable regret that we can highlight only five of these, though I think you will agree that they are indeed powerhouses.

Bob Morein's PD PROLOG is a public domain implementation of the fifth-generation language for MS-DOS and PC-DOS environments. Bob wrote the syntax to conform closely to the Edinburgh syntax, but his implementation contains several notable extensions.

Ralph and Madge Griswold present a tutorial on Icon, a high-level language that emphasizes the processing of strings and structures. The language was originally implemented under UNIX, but it has been transported to other operating systems, including MS-DOS.

Anthony Zackin has written an enhanced console driver that will allow you to create your own user interface for DOS. This replacement for the ANSI.SYS file performs all of that file's functions plus many, many more. Read and be informed.

Roedy Green's Abundance is a FORTH-based, data-entry, database, screen-handling language that performs a variety of housekeeping tasks automatically. The language was originally designed to serve charities, but it is now a complete business programming language.

Bob Baumann has written a Zilog Z80 and CP/M 2.2 emulator. With it, you may well be able to run some CP/M software on your IBM PC or compatible. We therefore asked Brock Meeks to summarize some of the best public domain CP/M programs. His selections are included in a "CP/M Hall of Fame."

There is a tremendous amount of code associated with this theme. Abundance, for example, comes on 15 disks. BYTEnet, BIX, and the disk copy service will be able to provide most, but obviously not all. Please read the editor's notes in each article carefully for instructions on how to obtain the programs.

In my mind, a much larger problem is that we cannot feature many more of the programs that were submitted. Although it was not ready in time for this issue, we hope soon to provide a new portable implementation of the SAIL language called PSAIL, which produces C code and uses run-time packages also written in C.

Other submissions are available now, and we are placing many of them on BYTEnet and BIX. These include New York Word, a fine shareware word processor for the IBM PC family, and a Turbo Editor, VT100 emulator, and Mandlebrot utilities from Tim McGrath. In addition to these programs, we have uploaded the text of an interview that Dave Betz and I carried out with Richard Stallman, the author of GNU (GNU's Not UNIX), a UNIX-compatible software system.

After reviewing a tremendous number of programs, I am pleased to report that the public domain is as vibrant and potent as ever.

—Jon Edwards, Senior Technical Editor

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PD PROLOG

BY ROBERT MOREIN

A public domain version of the fifth-generation language

PD PROLOG, an implementation of the Edinburgh syntax of Prolog, was a prototype for the commercial Prologs of which I am also the author. I intended the syntax of PD PROLOG to conform so closely to the Edinburgh syntax that it would be possible to execute PD PROLOG successfully with only W. F. Clocksin and C. S. Mellish's *Programming in Prolog* (Springer-Verlag, 1981) as a companion. Only two things distinguish PD PROLOG by their absence: debugging facilities and the definite-clause grammar syntax. And it contains several notable extensions to the Edinburgh syntax. [*Editor's note: For an introduction to Prolog, see "Prolog Goes to Work" by Clara Y. Cuadrado and John L. Cuadrado in the August 1985 BYTE, "Logic Programming" by Robert Kowalski in the same issue, and* Prolog for Programmers *by Feliks Kluzniak and Stanislaw Szpakowicz (Academic Press, 1985).*]

PD PROLOG runs under MS-DOS and PC-DOS and uses all memory allocatable by DOS. There is a definite advantage to having 640K bytes of RAM, so coresident programs that use a lot of memory should be excluded from the system.

PD PROLOG is not a completely integrated programming environment in the manner of BASIC because the edit and execute modes are distinct. You compose a Prolog program using a text editor (this can be done from within the Prolog environment), "consult" the program, and then execute it by giving goals. Users of small resident auxiliary editors or "notepad" programs will find the process considerably streamlined and fairly interactive. Also, the latest version of PD PROLOG comes with a screen-oriented text editor.

That is not to say that PD PROLOG is not a conversational language—the system prompt is ?-, which is the equivalent of "I am ready for your questions." A structure that you enter at this point is *not* construed as new knowledge to be entered into the knowledge base—rather, it serves as the initial goal of the backward-chaining inference engine, which is Prolog's inherent form of reasoning.

The fundamental Prolog statement is the Horn clause, or simply clause, which has two manifestations:

```
head( params ) :- body( params ).
```

and

```
unit( params ).
```

In the first type of clause, a rule, the head is true if the body is true; hence the head is the consequent and the body the antecedent. The unit clause, also known as a fact, has no body and is always true if selected. The params are optional variables or structures that, when present, pass and return values to the clauses and allow Prolog's pattern match to discriminate among clauses by embedded structure. A set of clauses with the same name, if they have the same number of params in the head, is variously referred to as a module or function.

PATTERN MATCHING

The selection process is guided by the resolution principle, one of the pillars of the Prolog computational process. The resolution principle is derived from predicate calculus and is closely related to proof by negation. But the basic operation is nothing

(continued)

Robert Morein is president of Automata Design Associates (1570 Arran Way, Dresher, PA 19025) and a physicist with an interest in non–von Neumann architectures and symbolic computation. He is the author of PD PROLOG and commercial Prolog development systems.

more than pattern matching. Thus Prolog would match the structure

alpha(1, X).

with the structure

alpha(Y, 2).

and the structure

'has a feature' (chimney, door, window).

with the structure

'has a feature' (X, Y, window).

Logic has no regard for computational complexity or the methods of finding the solution; it merely rigidly prescribes the correctess of the proposed solution and in this regard is hopelessly detached from the real-world considerations of finite resources and time. The method universally used for finding a solution is the backtracking depth-first search, which proposes to find the solution with the least expense, although it can be misled, which causes the program's downfall.

The backtracking search is a mechanical maze-searching procedure that can best be described visually. Imagine the clauses constituting a program as a tree, the search tree, through which Prolog will run, searching for satisfaction like a mouse searching for cheese. The ends of the tree are terminated with unit clauses, which are true if matched. The question becomes, is the tree finite or infinite?

Consider the following set of clauses:

```
a :- b.
b :- c.
b.
c :- b.
```

If you give the program the goal "a" at the system prompt (i.e., if you ask, "Is a true?"), the search will recurse infinitely, an example of misleading the backtracking inference engine. The set of clauses should be reordered:

```
a :- b.
b.
b :- c.
c :- b.
```

so that the system will see the economical solution: a if b, b is true, therefore, a is true.

VARIABLES

Prolog variables are denoted by a capital first letter. Thus, X, Varsym, and Param3 are legitimate variable names. A variable's scope is limited to the clause in which it appears and to the particular instance of usage of that clause. In the clause

a(X, Y) :- b(Y, X)

the values of X and Y are entirely private and are not seen even by other calls to that clause elsewhere in the search.

The binding of a variable to a value, known as "instantiation," is temporary in the following sense: The backtracking search requires that Prolog run in reverse as well as forward, and a variable must frequently be returned to the unassigned state. In forward search, the value of an instantiated variable cannot be reassigned, as it can in a conventional language. Prolog variables are "polymorphic"—they may be bound to a structure, list, number, or anything at all. Once bound, the variable itself disappears, being transparent to the resolution algorithm.

LISTS

A list is a data structure of the form

[element1, element2, element3, . . .].

The elements may themselves be lists or other data structures. The vertical bar, or list extraction operator, combines the virtues of LISP's car and cdr operators. For example, [X|Y] is the list with a first element of X and a remainder list of Y. Prolog's pattern matcher matches the two structures

[X|Y] = [a,b,c,d]

so as to set X = a, and Y = [b,c,d].

A functor-argument set is a basic structure: We take a group of structures separated by commas, enclose them in a set of parentheses, and give them a functor name, such as

alpha(X, 33, beta(xxx), [a,b,c]).

STRUCTURES

A classic example illustrates how Prolog constructs data structures, thus leaving the realm of passive tree searches.

Clause 1:
append([ ], L, L).

Clause 2:
append([X|List1], List2, [X|List3]) :-
        append(List1, List2, List3).

The general scheme is this: The definition consists of one fact and one rule. The rule will be used over and over again until what little is left of the goal given matches the fact. The [ ] stands for empty list.

The question that serves as the initial goal is

append([a,b,c], [d,e,f], Result).

Clause 2 is invoked with arguments

([a,b,c], [d,e,f], Result).

Clause 2 is invoked again with arguments

([b,c], [d,e,f], List3).

Clause 2 is invoked again with arguments

([b], [d,e,f], List3).

The arguments are now

([ ], [d,e,f], List3).

Clause 1 now matches. Since it is a unit clause, the search terminates.

How does this cause a list to be constructed? The key is in the third argument, which returns the constructed list to the uppermost, or first invoked, rule. The inference engine matches it to [X|List3] in clause 2. Now let's trace this (in figure 1) as clause 2 is successively invoked.

In clause 1, L is [d,e,f] for the following reason: Notice that clause 2 never alters List2 but supplies it to whatever clause it invokes. Thus, L in clause 1 is the original List2, or [d,e,f].

This example would not have worked if the order of clauses 1 and 2 were reversed. The backtracking, depth-first search strategy, which always attempts to use the first clause encountered, would have looped forever.

BUILT-IN PREDICATES

Built-in predicates are required to make PD PROLOG a programming

(continued)

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CWF-886

system. In one category of such built-in predicates is the *cut*, symbolized by an exclamation point, which modifies the search behavior. Without the cut, implementing the resolution principle would be practically impossible. Maintaining the search tree in such a way that backtracking is possible is feasible only for portions of a Prolog search. Once the program ascertains that the path chosen is a correct one, committing the system so that backtracking is not possible permits reclamation of large amounts of memory. It would be very desirable to use the exclamation point in conjunction with append in the following way:

```
modified_append( X, Y, Z ) :-
    append( X, Y, Z ), !
```

Thus, modified_append recognizes that there is only one way to append lists, and backtracking information need not be retained. The ! means that memory used need not be proportional to the amount of time spent in forward search. The cut is an extralogical feature, one that compromises Prolog's claim to be an implementation of predicate calculus, but it is necessary for practical programming.

Other built-in predicates construct data structures or have residual side effects. Accomplishment by side effect is typical of the way that parsers, or expression recognizers, construct data structures while seeming to answer the useless question "Is this a sentence in the language?" This is not a new idea. The predicate read creates a new structure in response to keyboard input or input from a file. The predicates asserta and assertz add new clauses to the database. Thus, if you were interested in adding integrated editing capability to PD PROLOG (so that you could add clauses without exiting to an external editor), you might write the following clause:

```
add :- read( X ), assertz( X ).
rem :- read( X ), retract( X ).
```

INPUT

The predicate see tells the PD PROLOG shell to accept goals from a file in place of the keyboard. You could write a form of another built-in predicate, consult, with the following primitives:

```
consultfile( Filename ) :-
        see( Filename ),
        repeat,
        doread( X ),
        assertclause( X ),
        var ( X ),
        see( Filename ),
        see( user ), !.

doread( X ) :- read( X ), !.
doread( _ ).

assertclause( X ) :- assertz( X ), !.
assertclause( _ ).
```

Note that repeat always succeeds upon backtracking. This causes the read. . .assert loop. The form of loop control depends upon the nature of the parameter of doread. When end of file is reached, the read predicate fails, and doread returns an uninstantiated variable. This is accepted by assertclause, although assert fails, so the variable test var is executed. If end of file has not occurred, var fails because X is a bound variable, so control backtracks to repeat, which always succeeds, causing another clause to be read. If end of file is reached, var succeeds, the input stream is closed by see(user), and consultfile succeeds.

THE CONTROL STRATEGY OF PROLOG

It has been thought by some that the backward-chaining inference engine built into Prolog prescribes and limits the method of problem solving. This, the opponents say, implies that a language like LISP, which manipulates structures on a lower level, is better for serious work because you can build an inference engine especially for the problem at hand.

I would argue, however, that while backward chaining is always conveniently available for problem solving, it can be viewed on another level as simply a control structure. All languages have control structures, which simply represent the bottom end of the capabilities of sophisticated inference engines. No one would suggest that the if, for, do, or while statements of the C language delimit what can be written in the language.

The simplest inference engine you can construct in Prolog is the one used by Prolog itself:

```
g( true ) :- !.
g( (E1, E2) ) :- !, g( E1 ), g( E2 ).
g( E ) :- clause( E, Antecedents ),
          interpret( Antecedents ).
```

The ! in the first clause modifies the behavior on backtracking so that the Prolog system never attempts the other g clauses. This is desirable because true is a Prolog quantity that is, by definition, true. The second clause simplifies a logical expression

(continued)

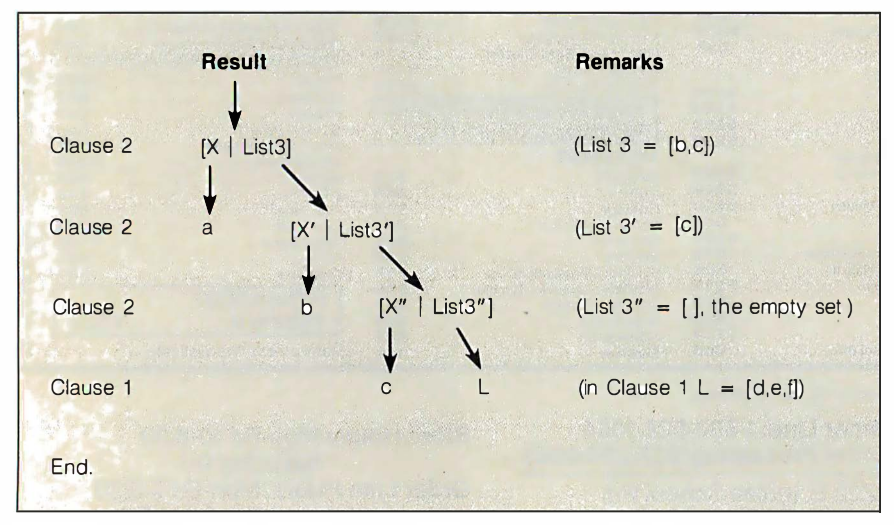
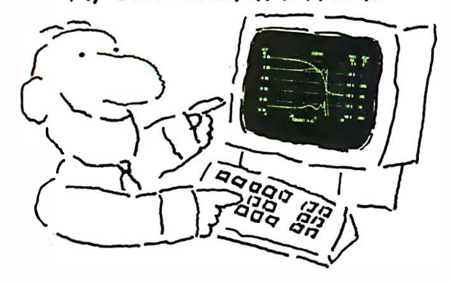


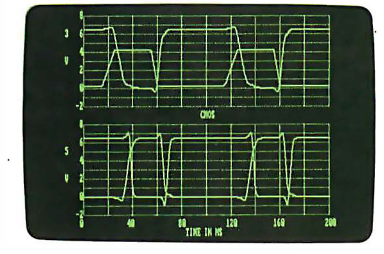
Figure 1: *The successive invocation of clause 2 (defined in the text of this article) with the end result* L = [d,e,f].

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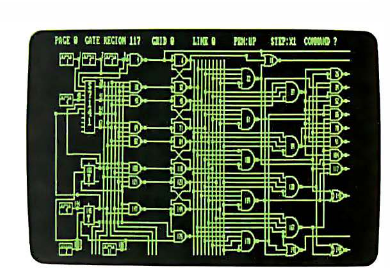
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by subdividing it into two smaller problems, or goals, while the cut blocks the third clause from ever trying to satisfy a logical goal. The third clause actually searches the database with the built-in predicate clause and tries to satisfy the antecedents of what it finds. In most cases, the third clause will be invoked first, then the second, and the first possibly not at all.

Thus, if you have a database of facts

```
alpha( X, Y ) :- beta.
alpha.
alpha( X, Y, z ).
```

and you give the Prolog system the goal

```
clause( alpha( Var, const ), Body )
```

a search will be made for clauses in the database matching the description given to clause. The only match would be

```
Var = X, Body = beta.
```

Backward chaining means to reason from a presumed form of the solution to find the proof that the solution is true. But this is only the basic motif of programming. Prolog is not a true implementation of predicate calculus

(continued)

A Prolog Strategy for Telecommunications Routing

BY LI SU

In my work for a large corporation, I was able to solve a common telecommunications problem in a flexible way. This corporation uses a private telephone network to communicate between various divisions located throughout the United States. The switching algorithm is handled locally utilizing routing tables prepared by a Prolog program. Optimal routing computed by an intelligent strategy is more efficient than a rigid star network topology.

My program implements these concepts in PD PROLOG. In figure A, the large boxes represent corporate divisions, and the small boxes represent telephones, numbered 1 through 16. The short lines represent local (direct-connect) phone lines, and the heavy lines represent long-distance lines. The phones connected by long-distance lines are gate phones between the individual offices.

The rules for making a call are as follows:

1. If two phones are connected to the same local line (e.g., PH01 and PH02), the call will be routed through directly. One local call is charged.
2. If two gate phones are connected by a long-distance line (such as PH04 and PH13), the call will be routed through directly. One long-distance call is charged.
3. If two phones are not covered by the preceding cases (such as PH05 and PH11), the call will first be connected to the local gate phone. One local call is charged. Then the call will be connected by a long-distance line to the next gate phone (it is picked by the Prolog program). One long-distance call is charged. The rest of the handling will be in the same manner until the call is finally through. The total charges for the call will depend on how many intermediate connections are made. This is one of the advantages of using local switching.

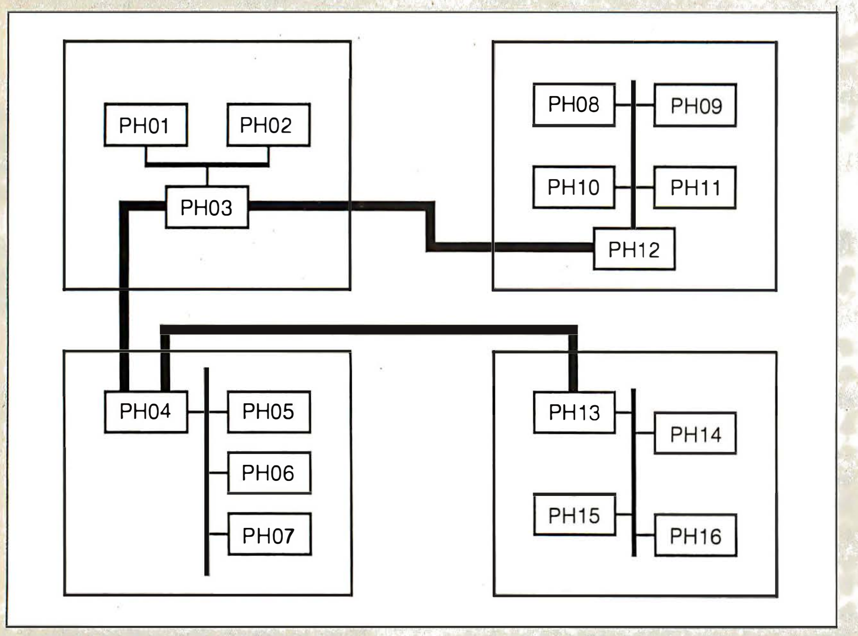


Figure A: *Example layout for a private phone network with 16 telephones in four offices.*

A text file contains a list of divisions, phone numbers, and gate phones. Another text file contains all the physical connections between two divisions and the type of each connection. The reason for keeping two text files is that adding or removing a phone number will have no effect on the physical connections. On the other hand, changing the physical connections will not impact the phone numbers.

Li Su (729 East 77th St. #301, Richfield, MN 55432) is a systems analyst working in the area of network management.

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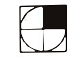
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*as reported in Micro Cornucopia, August-September 1985. Turbo Pascal is a registered trademark of Borland International.

and in fact has a procedural as well as logical interpretation. The side effects of a Prolog proof, which may intentionally never be completed, are usually the most important part. These effects are the accumulated irreversible effects of the built-in predicates, which can change the state of the system over time. The assert and retract predicates allow a Prolog program to modify the source code as a routine procedure and let you construct systems that learn.

The general problem solver notion (GPS) of Newell and Simon can be implemented easily in Prolog and exemplifies a forward-chaining inference engine (see listing 1). This is schematic code that ignores the great problem of all forward-chaining engines, which is to narrow down the search space and obtain optimal solutions. But consider for a moment a "travel" problem. You have a map of the United States. You wish to travel from New York to San Francisco. The road map is a network of nodes, each consisting of the intersection of two or more roads. Permitted moves are along roads. The procedure is roughly this:

1. Find a town closer to the destination.
2. Qualify the move. Is the town accessible by interstate, for example?
3. Select a method of travel (a road and conveyance).
4. Add this to the route that is being constructed.
5. Repeat this procedure unless the goal has been reached.

The monitoring of large systems can be easily handled through the state-variable approach. In such cases it does not suffice to consider only the variables local to a particular subprocess, since the goal is to avert hazardous conditions as well as recognize them. A Prolog system obtains a complete characterization of state, which is saved in added clauses. A logical analysis and recharacterization succeed each other indefinitely. The example in listing 2 gives the idea.

Listing 1: *A simplified general problem solver algorithm.*

```
progress( Current, Goal, Path_sofar, Path_sofar ) :-
     Current = Goal, !.

progress( Current, Goal, Path_sofar, Final_path ) :-
     find_move( New ),
     qualify( New ),
     select_op( Current, New, Method ),
     add_to_path( Path_sofar, New, Method, New_path_sofar ),
     progress( New, Goal, New_path_sofar, Final_path ).
```

Listing 2: *The state-variable monitoring approach.*

```
monitor_process :-
     repeat,
     get_state_of_system,
     check_alarm,
     fail.

get_state_of_system :-
     retractall( state_of_system ),
     read( Temperature ),
     read( Pressure ),
     assert( state_of( temp, Temperature ) ),
     assert( state_of( pressure, Pressure ) ).

check_alarm :-
     state_of( temp, T ),
     state_of( pressure, P ),
     Max is T * P,
     Max > 340,
     alarm_operator.

check_alarm.
```

Prolog Operators

Prolog is a simple language compared to something like Common LISP. Possibly jealous of LISP's complexity, syntacticians worked arduously to complicate Prolog's syntax. The user-definable operator, really a functor in disguise, was found to serve very well. A simple Prolog clause might be

```
alpha( arg1, arg2 ) :-
     arg1 = arg2, arg1 > 40.
```

but if we declare it as an operator

```
op( 40, yfy, alpha )
```

where op is a built-in predicate, 40 is the precedence, and yfy describes the associative properties, it becomes possible to write

```
arg1 alpha arg2 :-
     arg1 = arg2, arg1 > 40.
```

In DECsystem-10–compatible Prolog it also becomes possible to write complex expressions like

```
a op1 b + c
     - d op2 u xx v
     - y ** d op3 op4
```

To translate this, Prolog uses the display predicate, which displays operator-loaded expressions in functor format. Note that an operator performs no function by itself but is merely food for Prolog's inference engine, just like a functor.

An exception was made for arithmetic expressions. Evaluation of expressions containing the operators +, –, *, and / can be forced by the built-in predicate is. The goal

```
X is 3 + 4
```

which is really the same as

```
'is'( +(3,4), X )
```

results in X = 7, while the goal

```
X = 3 + 4
```

or

```
'='( +(3,4), X )
```

gives the surprising result

```
X = 3 + 4.
```

The dual mode facilitates symbolic manipulation of arithmetic expres-

(continued)

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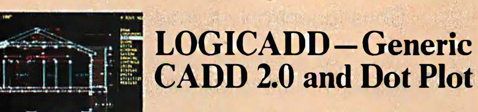
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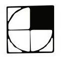
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PIE: A Prolog Knowledge

BY SIMON Y. BLACKWELL

While experimenting with modeling theories of knowledge via a computer, I found that no affordable expert system tools were flexible or powerful enough to meet my needs. Hence, I wrote PIE, a Prolog Inference Engine and Truth Maintenance System, using ADA Prolog (the commercial version of PD PROLOG).

Various versions of PIE have provided mechanisms for forward and backward chaining, consistency checking, and dependency-based truth maintenance. However, one of its most interesting features is an editor and compiler based on user-defined Prolog operators. Such an editor/compiler is outlined below.

To implement the editor/compiler, you write Prolog rules in which the goals are the same as the syntax of a higher-level language developed to represent the knowledge. (The design of the higher-level language is left to the reader.) The antecedent conditions should be a series of Prolog predicates that assert Prolog clauses to the Prolog database.

Suppose that only if is a logical connector in the higher-level language. Declare only if as an operator and define a rule as follows:

RULE 1

```
Consequent only if Antecedent :– asserta(Consequent:–Antecedent).
```

This rule will accept input from either the user or a stream opened using the Prolog predicate see(<file>). For example,

```
boy(X) only if (male(X),human(X),young(X)).
```

would result in

```
boy(X) :– male(X),human(X),young(X).
```

You can take this several steps further by declaring another operator, @. This will allow you to name rules and assign a certainty factor to them, as in

RULE 2

```
Rule @ Certainty @ Consequent only if Antecedents :–
     asserta(rule(Rule,Certainty,Consequent,Antecedents)),
     asserta(Consequent :– Antecedents,!,
                              low_antecedent_cert(Antecedents,L),
                              Cons-cert is ((Certainty * L) / 100))
                              asserta(Consequent),
                         asserta(fact(Consequent,Cons-cert,Rule))).
```

Note the Prolog rule that is asserted in Rule 2. A rule of such a form takes full advantage of the built-in Prolog inference engine. A programmer might be tempted to write rules or have the compiler write rules of the form of Rule 3.

RULE 3

```
fact(boy(X),Cert)): –fact(male(X),Cert1)),
                    fact(human(X),Cert2)),
                    fact(young(X),Cert 3)),
                    low_antecedent-cert([Cert1,Cert2,Cert3],L),
                    Cert is ((<rule-certainty> * L) / 100).
```

sions as well as simple evaluation.

PD PROLOG supports 97 built-in predicates, all of which are described in *Programming in Prolog* or in the PD PROLOG documentation. Ramachandran Bharath provides exercises in the use of PD and ED PROLOG in *Introduction to Prolog* (Tab Books, 1985).

The accompanying text boxes by Li Su and Simon Y. Blackwell demonstrate the power of PD PROLOG to handle specific, physically constrained problems as well as knowledge representation in the abstract sense.

Base Editor and Compiler

Such rules are not efficient because they generate a large list to be searched, the list of all structures with the functor fact.

Rule 3 may also have to be resatisfied if the goal fact(boy(X),Cert)) appears in several rules. Note, however, that all goals in Rule 2 are asserted once satisfied. This prevents them from having to be satisfied multiple times. Asserting the satisfied goal to the top of the database stack is very important; otherwise subsequent calls to the goal will reinvoke the rule, since the rule will be higher in the search stack.

The assertion of rule(Name,Certainty,Consequent,Antecedents) in Rule 2 gives you the ability to retrieve, print out, reason about, or reference rules easily. The assertion of fact(Consequent,Cons-cert,Rule) allows you to track the certainty of and provide justification for the facts.

I have left the definition of the predicate low__antecedent__cert to the reader. Given the Antecedents, the predicate should return the lowest certainty by retrieving their fact forms with attached certainties.

Cons-cert is ((Certainty * L) / 100) multiplies the certainty in the rule by the lowest antecedent certainty to determine the certainty in the consequent. I've arbitrarily chosen a scale of 1 to 100 for this example.

The efficiency of certainty propagation could be improved by tagging each fact directly, for example, boy(X,Certainty). Such an implementation removes the need to search for certainties after satisfying the antecedent goals. However, this is at the expense of considerably complicating the editor/compiler.

A final modification of the editor/compiler will allow a threshold certainty to be placed on the rule. If the certainty in the antecedent conditions is below a set limit, the goal will then fail. This is accomplished by

```
Rule @ Certainty @ Threshold @ Consequent only if Antecedents :-
asserta(rule(Rule,Certainty,Threshold,Consequent,Antecedents))
assert(Consequent :-  Antecedents,!,
                      low__antecedent__cert(Antecedents,L),
                      L < Threshold,
                      Cons-cert is ((Certainty * L) / 100),
                      asserta(Consequent),
                      asserta(fact(Consequent,Cons-cert,Rule))).
```

This rule will accept input of the form

```
rule-1 @ 100 @ 75 @ boy(X) only if (male(X),human(X),young(X)).
```

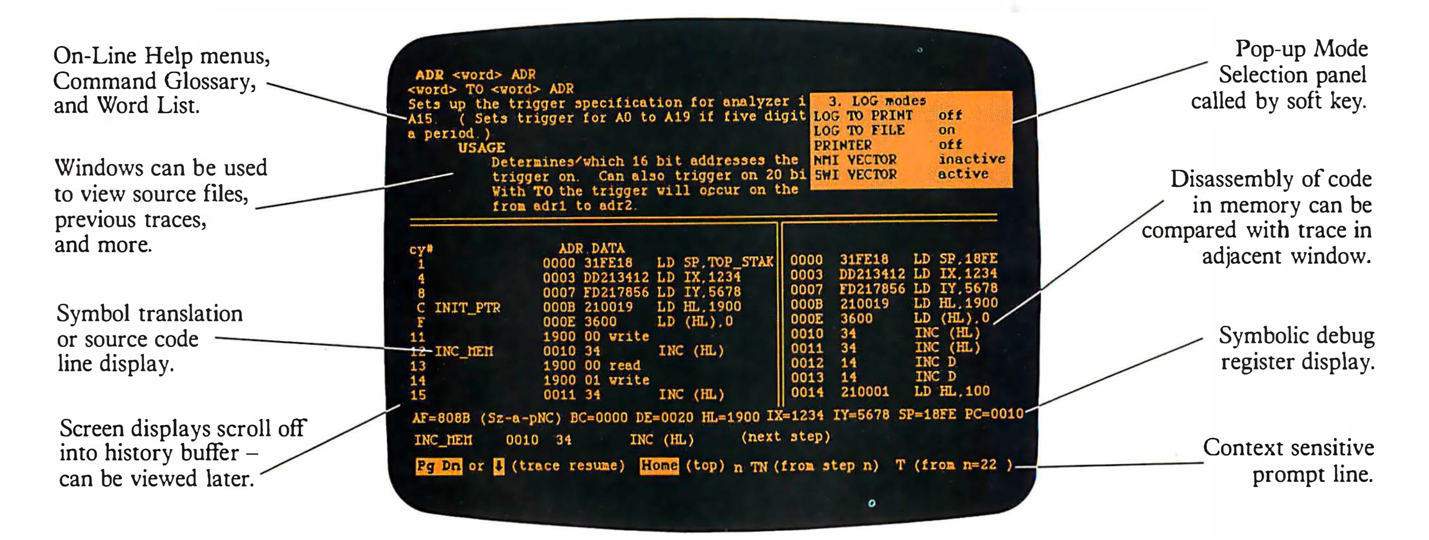
As a result, boy(<something>) would never be asserted with less that 75 percent confidence.

The same principles, with some embellishment, can be used to convert input like X is a boy into boy(X), create a frame-based inheritance system, or implement dependency tracking and forward-chaining mechanisms. For example, for a general forward chainer, you would declare an operator implies, define your own assert predicate, and utilize rule facts like those asserted by the editor/compiler outlined here.

Simon Y. Blackwell (Inference Corp., 2777 Summer St., Suite 402, Stamford, CT 06905) is a knowledge engineering consultant.

Editor's note: PD PROLOG is available on disk, and on BIX. See the insert card after page 320 for details. Listings are also available on BYTEnet. See page 4. You will need an IBM PC or compatible with 256K bytes of memory and MS-DOS 2.0. There are four compressed files: PDPROLOG.EQE, PROLOG.DQC, PROLOGED.CQM, and PRCONF.EQE, as well as USQ.EXE, which you will need to decompress them. Simon Blackwell's expert system shell, PIE, is also available. The files are KNOW.PQO, PIE.PQT, and KOPS.QQQ, which must also be decompressed with USQ.EXE. ■

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BY RALPH E. GRISWOLD AND MADGE T. GRISWOLD

An expression can produce a sequence of results if it succeeds—or none at all if it fails

ICON IS A high-level, general-purpose programming language that emphasizes nonnumeric computation, that is, the processing of character strings and structures. It is written in C. Originally implemented under UNIX, Icon has been transported to other operating systems including DOS and VAX/VMS. It runs on machines ranging from personal computers to mainframes. Its application areas include artificial intelligence, expert systems, symbolic mathematics, text generation, editing, analysis, string processing, program generation, cryptography, language translation, molecular genetics, and others. [*Editor's note: Versions for* MS-DOS, UNIX, *and* VAX/VMS *are available from the authors in executable and* C *source code. The* MS-DOS *executable code and some sample programs are available on* BIX *and* BYTE*net under the following filenames:* ICONREAD.ME, ICONT.EXEC, ICONX.EXE, ILINK.EXE, ITRAN.EXE, HELLO.ICN, CROSS.ICN, CROSS.DAT, MEANDER.ICN, MEANDER.DAT, ROMAN.ICN, WORDCTN.ICN, OVERVIEW.DOC, EXTEN.DOC, RUN.DOC, REGIS.FRM, *and* TROUBLE.FRM. *See page 4 and the insert card following page 320 for details. For the source code, write to the Icon Project, Department of Computer Science, The University of Arizona, Tucson, AZ 85721.*]

The design of Icon stresses ease of programming, which permits short, concise programs. It has two major characteristics: expressions that can produce sequences of results and a goal-directed evaluation that automatically searches for solutions. In addition to a large repertoire of simple string operations, Icon has a high-level string-scanning facility for pattern matching.

Its data structures include lists with stack and queue access, sets that can have members of any type, and tables with associative lookup. A data structure can have values of various types. For example, a list can contain both integers and strings—and even lists. Icon also has automatic storage management; it creates objects at run time instead of during compilation. And you don't need type declarations; Icon has run-time checking and automatic type conversion.

GENERAL ASPECTS OF ICON

You may not notice anything unusual if you look at an Icon program. It looks a lot like a Pascal, C, or PL/I program. It is not distinctive in appearance. Icon's distinctive aspects lie in its unusual expression-evaluation mechanism, its data structures, and its emphasis on high-level processing of character strings.

An Icon program consists of a collection of procedure declarations within which are the expressions that carry out the program's various computations. The simple program

```
procedure main( )
   write ("welcome to outer space")
end
```

does what you think it would—it writes out "welcome to outer space."

(continued)

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The syntax of expressions in Icon is similar to that in most other programming languages. There are the usual operations, both unary (prefix) and binary (infix), function calls, reserved words for control structures and declaration components, and so on. This article does not contain details of the syntax, but the examples given provide the general idea. A precise description of Icon's syntax is found in reference 1.

To understand Icon, you need to have a general idea of the types of data it supports and the operations it performs on that data. In addition to integers and real (floating-point) numbers, Icon supports many less conventional data types, including strings (ordered sequences of characters), "csets" (unordered sets of characters), lists (ordered sequences of values), sets (unordered sets of values), and tables (unordered sets of value pairs). Icon even considers procedures to be data types.

You can represent integers, real numbers, strings, and csets literally. The syntax is conventional; for example,

```
i := 20
n := 3.14159
greeting := "howdy"
vowels := 'aeiou'
```

Identifiers are sequences of letters, and the := operator indicates assignment. Strings and csets are enclosed in double and single quotes, respectively. Many operations compute values for the various data types.

Since Icon has no type declarations, any variable can have any type of value at any time, depending on what happens during program execution. For example, you can write

```
x := 1
  . . .
x := "hello"
```

Icon takes care of type checking and conversion; you don't have to specify them when writing your program. You can even use types that are collections of values. A list, for instance, may have values (elements) of different types. An example is city := ["Tucson",500000,1986]. The square brackets enclose the three list values, one of which is a string while the other two are integers. This ability to have *heterogeneous* structures often allows programs to be written more concisely. The freedom from type declarations certainly makes it easier to write programs albeit at some expense in efficiency and error checking.

EXPRESSION EVALUATION

One thing that distinguishes Icon from other programming languages is the method it uses to evaluate expressions. In most programming languages, an expression always produces a result—one result. It may be difficult to imagine how this could be otherwise. After all, computation *means* the production of a result. On the other hand, every programming language has conditional operations. An example is if i < j then write(i). Usually, a conditional operation such as i < j produces a Boolean value, either true or false, depending on the specified relation. (Some languages use nonzero and zero integer values in place of Booleans but with the same meaning.) Control structures then test these values.

Icon takes another view of this situation: In Icon, if the relation does not hold (if i is not less than j, for example), the corresponding expression does not produce a result; it *fails*. However, if the relation does hold, the expression does produce a result—its right argument; it *succeeds*. Thus, i < j fails if i is not less than j and produces no result; but it produces the value of j if the expression succeeds, that is, if i is less than j. Correspondingly, control structures in Icon are driven by the success or failure of their control expressions rather than by Boolean values.

These conditional operations appear exactly the same as they do in conventional languages, but Icon offers other possibilities. For instance, control expressions are no longer limited to those that produce Boolean values. In Icon, you can use any expression as a control expression. It may produce a meaningful result, or it may fail. Since the result is not limited to being Boolean, you can use it in another computation. Consider, for example, while line := read( ) do write(line). The function read( ) produces the next line, if there is one, from standard input but fails at the end of the file. The value it produces is used in assignment, but the loop terminates at the end of the file. This has two important side effects. First, it eliminates any need for end-of-file testing; it follows automatically from the read function. Second, it is not an error for an expression to fail to produce a result; it is a normal consequence of computation.

In Icon, failure is "inherited," since, if an expression fails, there is nothing to operate on and no result can be produced. Thus, you can write this example more concisely if you omit the do clause and combine the read and write as in while write(read( )).

The distinction between success and failure in Icon's expression evaluation is only the beginning. In some situations, a computation may have more than one possible result. For example, the following function produces the position of one string that exists as a substring of another:

```
s := "There are several errors"
   find("er",s)
```

The string, or substring, "er" occurs at three different places in the string s. Most programming languages solve this ambiguity by picking one of the three results—usually the first one. Of the three positions—3, 14, and 19—two would be discarded. If the discarded possibilities are needed, they must be obtained by using substrings or some similar mechanism. In Icon, however, an expression can generate a sequence of results if that is appropriate in context. There are two contexts in which this may be appropriate: iteration and goal-directed evaluation. The control structure every *expr1* do *expr2* performs iteration and causes *expr1* to produce all its results in sequence. For every result *expr1* produces, Icon evaluates *expr2*. For example, the function find can generate all positions, so that for the value of s given above, every i := find ("er",s) do write(i) writes 3, 14, and 19. Generation, like failure, is inherited; therefore, you can write this expres-

(continued)

sion more compactly as every write (find("er",s)).

While iteration forces an expression to generate all its results, there are many situations in which you need only one result. Therefore, i := find ("er",s) assigns the value 3 to i. This method generates no more results since they are not needed. Thus, conventional expression evaluation occurs automatically if you don't use a context that generates more than one result.

Another possibility: There are often several possible solutions to a problem, but they don't all satisfy a larger goal. A simple example would be determining whether "er" occurs in both s1 and s2. It may occur in several positions in both, but locating a *common* position is laborious in most programming languages. Icon automatically forces expressions to produce results if they are needed to satisfy a condition in an *enclosing* expression. An example: find("er",s1) = find ("er",s2) succeeds if and only if "er" occurs at the same position in s1 and s2 (the operator = compares for numerical equality).

The mechanism is simple and automatic. If the left and right expressions produce results, but they are not equal, Icon generates the next result from the right expression. This process continues until either the comparison succeeds or the right expression has no more results. If the right expression has no more results, Icon generates the next result of the left expression, and each of the results for the right expression is generated again. It is simple and natural and straightforward. Much of the conciseness of Icon programs comes from the use of this facility—and it is completely general; it applies to all expressions and to all types of results in all contexts.

Given the idea of expressions that can produce sequences of results, there are all kinds of possibilities. For example, i to j is an expression that generates the integers from i to j. Thus, you can write a for-style control structure using every. . .do, as in every i := 1 to 10 do f(i). The rigid format of the for-style control structure in conventional languages is not needed. You can write this expression more concisely as every f(1 to 10).

Another control structure that follows naturally from having sequences of results is *alternation*: *expr1* | *expr2* produces the results for *expr1* followed by the results for *expr2*. In conditional contexts, this amounts to logical disjunction. For example, if find ("er",s) = (4 | 14) then write(s) writes the value of s if it contains "er" at position 4 or 14. In iterative contexts, alternation has the effect of "*expr1* then *expr2*." For example, every write(find("er",s1 | s2)) writes all the positions of "er" in s1 followed by all the positions of "er" in s2.

Listing 1: *An Icon procedure to produce the larger of two numbers.*

```
procedure max(i,j)
    if i > j then return i
    else return j
end
```

Listing 2: *An example of how a procedure can fail.*

```
procedure greater (i,j)
    if i > j then return i
    else fail
end
```

Listing 3: *A procedure to generate the successive powers of a number* i.

```
procedure powers(i)
    j := 0
    repeat {
        suspend i ^ j
        j +:= 1
        }
end
```

PROCEDURES

Procedures provide a way of extending Icon's built-in repertoire of operators and functions. For example, Icon has no function for producing the larger of two numbers. The procedure in listing 1 does this. You call such a procedure exactly the same way you call a function: write(max(i,j)).

It can also fail the same way a function can fail (see listing 2). In this case, if i is not greater than j, the procedure fails.

An Icon procedure can also be a generator, by using suspend instead of return to produce a result. When a procedure suspends, its environment is left intact and you can resume executing the procedure to produce another result. For example, the procedure in listing 3 generates the successive powers of a number. The expression i ^j produces i^j. The procedure suspends for the first time when i is raised to the zeroth power (i.e., is equal to 1). If the procedure resumes to obtain another result, j is incremented (j +:= 1 is an abbreviation for j := j + 1). The repeat control structure is a loop that never terminates. Thus, the procedure powers next suspends when j is raised to the first power, then when it is squared, cubed, and so on. For example, powers(2) generates 1, 2, 4, 8, 16, and so on. Note that this generator produces an infinite sequence (or could, except for arithmetic overflow). An infinite generator presents no problem unless you use it in an iterative context. There is also a control structure *expr1* \ *expr2* that limits the number of *expr1* results to at most the value of *expr2*. Thus, every write(powers(2)) \ 5 writes 1, 2, 4, 8, 16.

STRING PROCESSING

After considering the possibilities of Icon expression evaluation, character string processing may seem mundane. Nonetheless, much computing involves string processing, and conventional programming languages have limited facilities for such computations. Icon has two levels of string processing: analyzing and synthesizing strings based on character position, and pattern matching, which lets you scan strings without worrying about the details.

First, while strings are sequences of characters, Icon has no character data type. Strings can be arbitrarily long, limited only by available memory space. The underlying character set of Icon is ASCII-based. Any 8-bit ASCII character (including the null character)

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can occur in an Icon string. Thus, Icon can process binary data as if it were string data. Icon strings are *not* arrays of characters. You cannot *change* a character within a string, although there are many ways to create new strings from old ones. This property lets you think of strings as atomic objects that cannot be corrupted.

Since a string is a sequence of characters, concatenating two strings to form a longer one is a natural operation. In Icon, concatenation has the form s1 || s2. For example, the sequence

```
s1 := "welcome aboard"
s2 := "mate"
s3 := s1 || ", " || s2
```

produces the value "welcome aboard, mate" in s3. Since Icon handles storage management automatically, you don't need to know—or worry about—how long a string is. (The operator *s produces the length of s in characters if you need it.)

Icon has a number of other operations for constructing strings. For example, repl(s,i) produces i number of concatenations of s; and left(s,i) constructs a string of length i with s positioned to the left and padded with blanks to the right if needed.

Much string processing involves analysis—locating the positions of substrings—or extracting specified

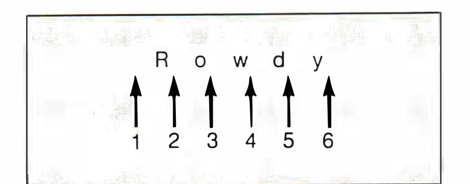


Figure 1: *A string's character location numbers start to the left of the first character.*

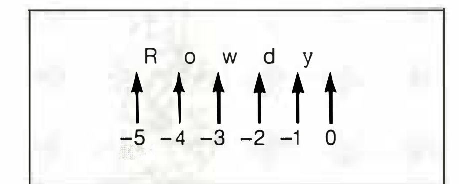


Figure 2: *String positions can also start from the right and decrease in number. However, character referencing still begins from the left.*

positions from a string. A string's character locations are specified by positions that are *between* the characters, starting at 1 (which is prior to the first character, as in figure 1). A substring within another string is specified by its bounding positions. For example, if the value of pet is "Rowdy", then pet[1:4] specifies the substring "Row". If you need only a single character, you can omit the second position, so that pet[1] specifies "R". You may assign this substring to another string, as in nickname := pet[1,4]. This expression assigns a new string "Row" to nickname; it does not change the value of pet.

Since Icon cannot change the characters in a string, it has a convenient abbreviation that appears to do this. If you assign a substring of a variable, Icon constructs a new string to replace the value of the subscripted variable. For instance, pet[1] := "D" appears to change the value of pet to "Dowdy". Icon really performs a concatenation: pet := "D" || pet[2:6]. Consequently, the first character of pet has not really been modified; pet has been assigned an entirely new string. A moot point, perhaps, but a different approach nonetheless.

If you don't know how long a string will be when you write a program, you can specify string positions in a decreasing fashion starting from the right as illustrated in figure 2. Thus, pet[−1] is "y." Note that although the numbering starts from the right, the position number for a particular letter still commences from the left.

While strings are useful for representing all kinds of textual material, there are situations in which the *order* of characters is not important but the properties of the character set are. Csets provide this facility and can be

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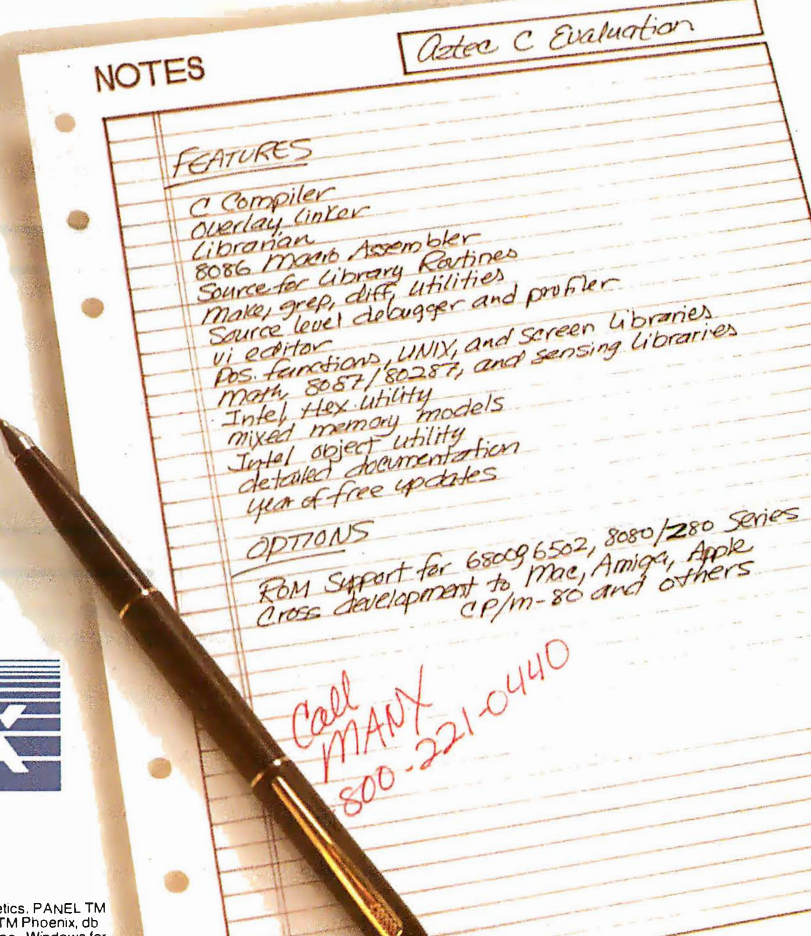
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specified literally.

Built-in csets are keyword values (values of special importance to Icon). A keyword name begins with an ampersand; for example, some cset-valued keywords are &lcase, &ucase, and &cset. The first two have cset values consisting of the lowercase and uppercase letters, respectively. The last, &cset, is the set of all 256 ASCII characters. You can perform set operations on csets. For example, the cset union &lcase ++ &ucase consists of all the lowercase and uppercase letters in the alphabet. Similarly, the cset difference &cset -- &lcase, consists of all ASCII characters except the lowercase letters.

Both strings and csets are used for analyzing textual material. The function find(s1,s2) is an example. A similar function, upto(c,s), generates the positions of the characters in the cset c that occur in s. For example, the code in listing 4 writes 3, 5, 7, 9, 12, 14, 16, 19, and 22. Both find and upto have an optional third argument that tells Icon where to begin. If you don't specify that argument, Icon assumes it is position 1, the beginning of the string being examined. However, you can specify any other value. For example, every write(upto('aeiou',s,10)) writes 12, 14, 16, 19, and 22, the vowel positions beyond the tenth position, for the same s. Another function that uses csets is many. For example, many(c,s) will skip as many characters as it finds at the beginning of s and produce the position in s following those characters.

You can use the functions upto and many, which produce positions, in combination with subscripting operations. For example, if you define a word to be a sequence of uppercase and lowercase letters, the program in listing 5 will break a text file into individual words and write them out individually. For each line, i starts at 1. The position of the first letter is assigned to j; then i is set to the position of the last letter starting from that point. The value of line[j:i] is the word itself. The process continues until there are no more letters starting at i. Then another line is read and processed, and so on. For example, if the input file consists of the data in table 1, the output of the program will appear as in table 2.

This typifies low-level string analysis: It computes positions, determines substrings by position, and so on. String scanning handles much of this detail automatically. In a string-scanning expression, which has the form *expr1* ? *expr2*, the string value of *expr1* provides the subject for analysis—corresponding to line in the example—and *expr2* contains matching functions that operate on this subject, automatically changing position as they find specified substrings. The position starts at 1. One matching function, tab(i), sets the position to i and returns the substring located between the old and the new positions. Since i is a position, it can be provided by a function like upto, which assumes it is examining the current subject if you omit its second argument. Using string scanning, you can rewrite listing 5 as listing 6, and you don't need to

(continued)

Listing 4: *The Icon code to generate the positions of the various vowels in* s.

```
s := "There are several errors"
every write(upto('aeiou',s))
```

Listing 5: *The Icon code to break a text file into its individual words and write them out one at a time and one to a line.*

```
procedure main()
   letter := &lcase ++ &ucase
   while line := read() do {
      i := 1
      while j := upto(letter,line,i) do {
         i := many(letter,line,j)
         write(line[j:i])
         }
      }
end
```

Listing 6: A *rewrite of the code in listing 5 using string scanning.*

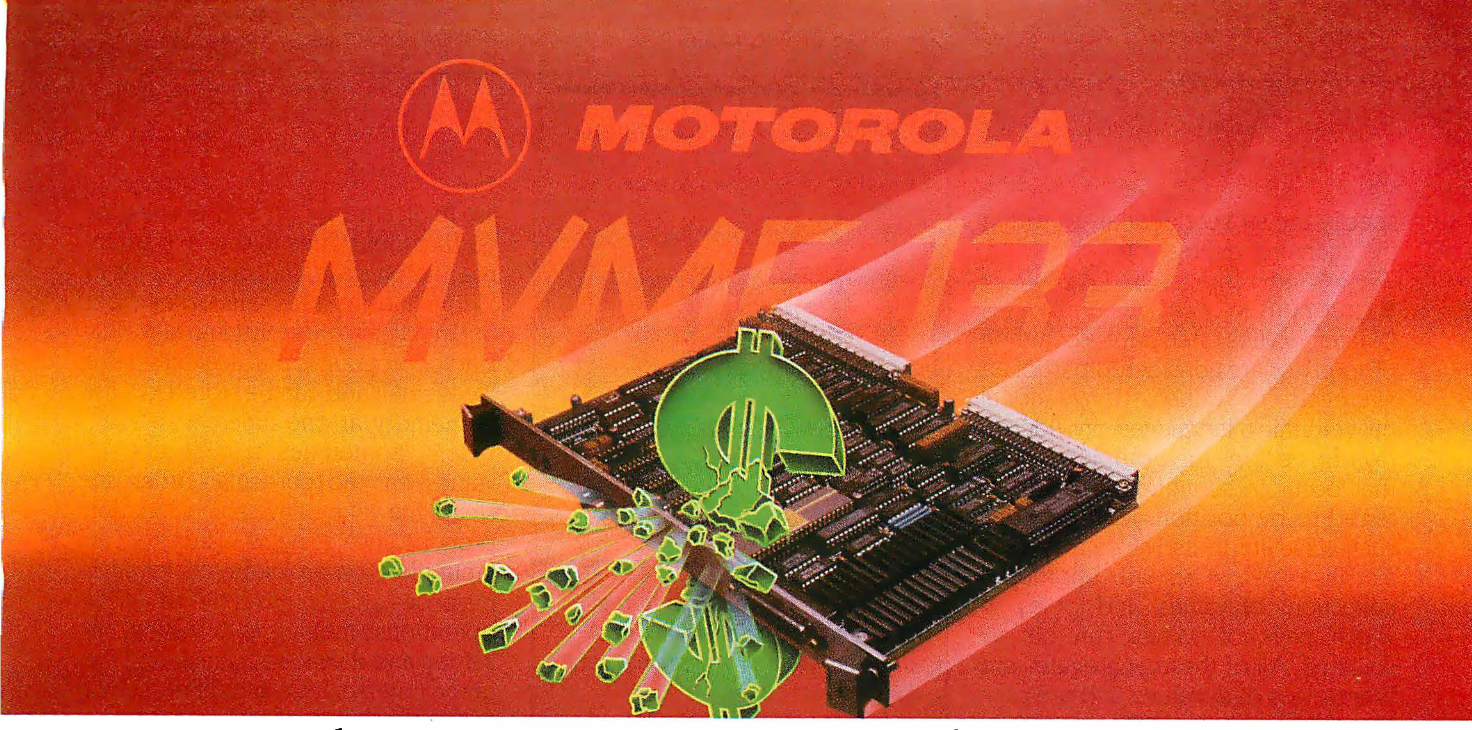
```
procedure main()
   letter := &lcase ++ &ucase
   while line := read() do
      line ? while tab(upto(letter)) do
         write(tab(many(letter)))
end
```

Table 1: *The input file used for the examples in this article.*

It was the best of times,
it was the worst of times,
it was the age of wisdom,
it was the age of foolishness,

Table 2: *The output from the code in listing 5 when table 1 is its input.*

It
was
the
best
of
times
it
was
. . .



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specify the subject of analysis within the scanning expression.

STRUCTURES

Different values often have a common property or are considered part of an aggregate of values. Conventional programming languages provide arrays or vectors for grouping values that occur in sequence and are referred to by position. Icon provides such a facility in its list data type. It also has sets, which are unordered collections of values, and tables, in which pairs of values can be associated. All of these aggregates are themselves data values and are constructed during program execution. Therefore, you can compute their sizes as you need them rather than having to specify them when you write the program.

Lists. A list is a sequence of values. You can construct a list by specifying its elements explicitly or by specifying its size and the initial values of all its elements. For example, tabulation := list(1000,0) assigns a list of 1000 zero values to tabulation. You can reference list elements by position by using their subscripts, and you can change them by assignment, as in tabulation[30] := 10, which changes the 30th element of the list to the value 10.

A list element is a variable and, like other variables in Icon, can have any type of value, for example, tabulation[1] := "first place". Since a list is a sequence of values, it is natural to have a generator (!a) produce this sequence. For example, every write(!a) writes out all the values in a. Since a list points to the aggregate of its elements (the address where the elements are kept), a list element may also be a list. For example,

```
node1 := ["a",0]
node2 := ["b",0]
node1[2] := node2
node2[2] := node1
```

The zero values are place holders that are then replaced by list values. Figure 3 depicts graphically the resulting structure. Therefore, you can use lists in Icon to represent graphs and other structures that have connections between various objects. Note that these lists are heterogeneous, consisting in this case of a string value and a list value.

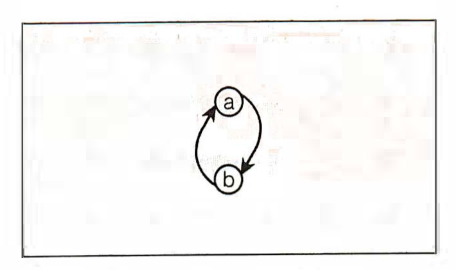


Figure 3: *A graphic representation of the structure of an Icon list.*

Listing 7: *The Icon code to read in all the lines in a file and write them out again in reverse order, last line first.*

```
procedure main()
    lines := []
    while push(lines,read())
    while write(pop(lines))
end
```

Arrays in most languages are fixed in size and can be referenced only by position. Icon supports stack and queue access to its lists to allow them to grow and shrink. The function push(a,x) pushes the value x onto the beginning (left end) of the list a, increasing its size by one. The function put(a,x) puts the value of x onto the right end of a, also increasing its size by one. Correspondingly, pop(a) removes the leftmost value from a, whatever it may be, and fails if a is empty. The rightmost value is similarly removed by pull(a).

You can use push and pop in combination to make a list look like a stack—a last-in, first-out data structure where you add and remove values at the same end. The function get is synonymous with pop; therefore, you can use put and get to make a list look like a queue—a data structure where you add values to one end and remove them from the other.

Often a program reads data from an input file and puts it into a list for processing, yet you don't know the number of input lines you will have when you write the program. You can handle this by starting with an empty list (indicated by [ ]) and pushing or putting input lines into it. For example, the program in listing 7 reads in all the lines of a file and writes them out in reverse order, last line first. This kind of program is practical only if the file is small and can be stored in a list in memory at one time.

Sets. Sometimes a collection of values has no particular order. Instead, the values have some common property such as being words from an input file. Icon provides sets for such purposes and supports the usual set operations: membership testing, insertion and deletion of values, and the union, intersection, and difference of two sets.

The function set(a) creates a set from list a. For example, articles := set(["the","a"]) creates a set with two members. You can insert, or add, a member to a set, as in insert(articles,:"an"); adding a member more than once has no effect. The number of members in a set is limited only by the amount of memory available. Sets also share several other characteristics with lists: The operator !s generates all the members of set s; a set value is a pointer to one of that set's members; and sets can have members of different types. A set can even point to itself as a member! For example,

```
s := set(a)
insert(s,s)
```

There is no paradox here since a set value is just a pointer; the challenge is to find a constructive use for this capability.

The program in listing 8 illustrates one use of sets; it writes a list of all the different words that occur in the input file. The function sort produces a sorted list, so that the words are written in alphabetical order (see table 3). Each word appears only once regardless of the number of times it appears in the input file. Note that "It" appears before words beginning with lowercase letters because uppercase letters precede lowercase ones in the ASCII collating sequence.

Tables. While lists deal with sequences of values and sets handle unordered collections of values, Icon uses tables containing value pairs to

Listing 8: *An illustration of one use of Icon sets. This program writes a sorted list of all the different words that occur in an input file.*

```
procedure main()
   letter := &lcase ++ &ucase
   words := set([])
   while line := read() do
      line ? while tab(upto(letter)) do
         insert(words,tab(many(letter)))
   every write(!sort(words))
end
```

Table 3: *The output from the program in listing 8 when table 1 is its input.*

```
It
age
best
foolishness
it
of
the
times
was
wisdom
worst
```

associate two values—for example, the number of times a word occurs in a file. One value, such as a word, is used as a key to index the table; the other value, such as the number of times the word occurs in the file, is associated with the key. Keys are unique in any table; only one value can be associated with a given key.

To create a table, you use table(x), where x is the default initial value automatically associated with new keys. Tables are initially empty. To add pairs to a table, you subscript the table with a key and assign a corresponding value. Thus, if t is a table, t["the"] := 1 assigns the value 1 to the key "the" in t. Tables grow automatically as you assign values to new keys; the size of a table is limited only by the amount of memory available.

Since you can compute keys, you may need to find out what keys are

(continued)

Listing 9: *An illustration of one use of Icon tables. This program lists alphabetically all the words in the input file with a count of how many times each one occurs.*

```
procedure main()
   letter := &lcase ++ &ucase
   wordcount := table(0)
   while line := read() do
      line ? while tab(upto(letter)) do
         wordcount[tab(many(letter))] +:= 1
   wordlist := sort(wordcount,3)
   while write(get(wordlist), " : ", get(wordlist))
end
```

Table 4: *The output from the program in listing 9 when table 1 is its input.*

```
It : 1
age : 2
best : 1
foolishness : 1
it : 3
of : 4
the : 4
times : 2
was : 4
wisdom : 1
worst : 1
```

in the table: To do this, you can produce a corresponding list in which keys and their values alternate with a := sort(t,3), where sort (with a second argument of 3) produces a list sorted on the keys. (Other second arguments for sort will produce different kinds of sorting for tables.)

The program in listing 9 illustrates the use of tables; it lists all the words occurring in the input file with a count of how many times each one occurs. The output is shown in table 4. Note that the initial value for a new key is 0. The final line of the program uses get(a) to extract alternate keys and their values. The function write may have several arguments; if it does, they are automatically concatenated on the output line.

Other Features. Icon also has a number of other features worth noting (see reference 1 for a complete description).

- Icon has an extensive repertoire of functions and operations for performing numerical computation, string analysis and synthesis, and list processing.
- You can call Icon procedures recursively, allowing you to handle recursively defined structures, like trees, in a natural way. Generators also can be recursive.
- You can declare records whose elements are referenced by names. This lets you extend Icon's repertoire of built-in data types.
- You can contain expressions in *co-expressions*, so that generators can produce their results as needed throughout a program.

IMPLEMENTATIONS

Icon includes a translator, a linker, and a run-time system. The translator converts an Icon source program to an intermediate form that consists of instructions for a "virtual" machine. This virtual machine can be thought of as an Icon machine, although it is implemented in software, not hardware. (A description of the implementation appears in reference 2.) The linker combines virtual machine code from separately translated modules and produces a binary output, much like an assembler produces executable binary code from assembly language input.

When an Icon program executes, the binary code is read into memory and interpreted. Using an interpreter rather than executing compiled machine code provides portability and flexibility. In addition, the interpreter is only slightly slower than the compiler that was originally used. Compilation does not provide a big performance improvement because many Icon operations are executed in compiled run-time subroutines. This is true regardless of whether the source program is compiled into executable machine code or translated into a machine-independent form for interpretation.

IN CONCLUSION

Icon is a multifaceted, multifunctional, character-string processing language available in the public domain. Its method of evaluating expressions—producing a result (or sequence of results) if the expression succeeds, and no result if it fails—distinguishes it from other high-level programming languages. Since Icon is written in C, it runs on a wide range of computers with little or no modification; you do, however, need a production-quality C compiler and library to compile it from source code. If you don't have a C compiler, executable binary files for DOS 2.0 or higher are also available.

ACKNOWLEDGMENT

Icon is a result of ongoing research in programming languages supported by the National Science Foundation and The University of Arizona.

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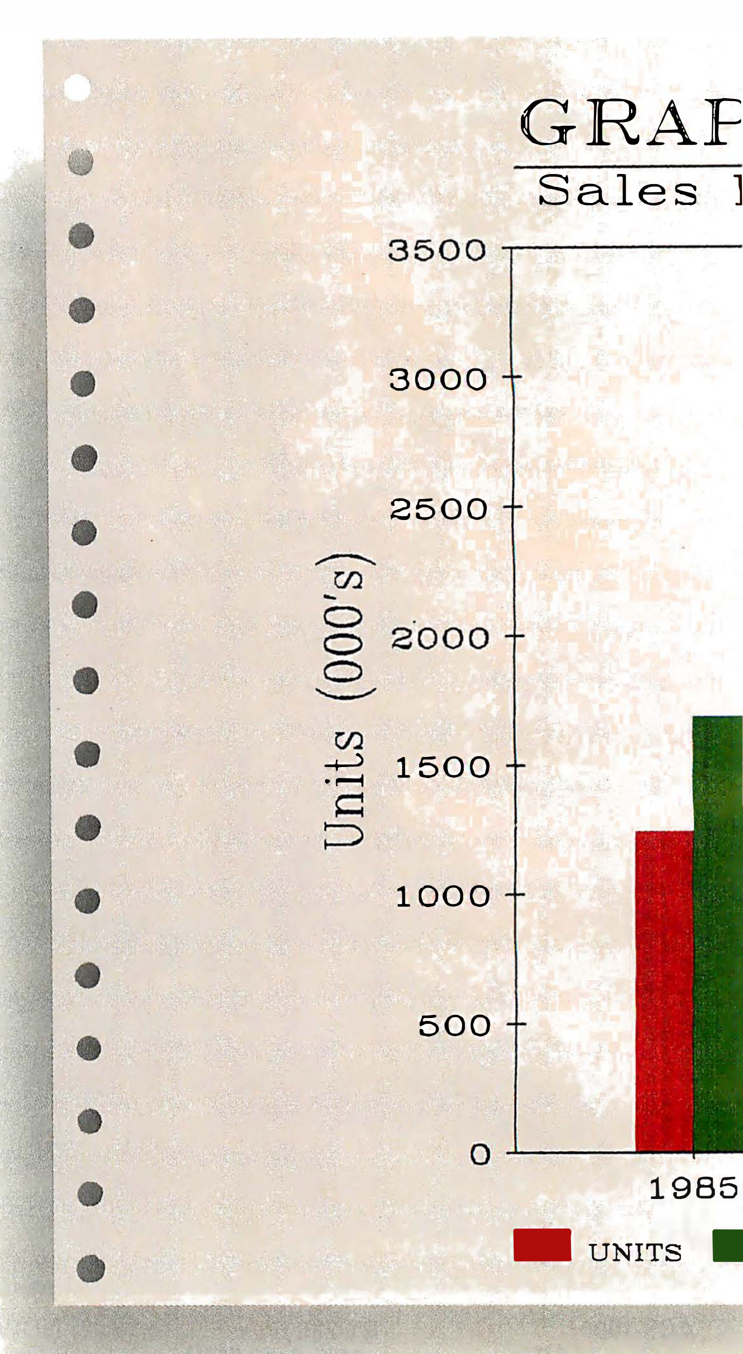
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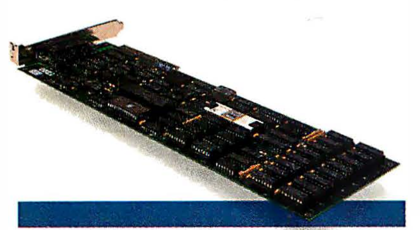
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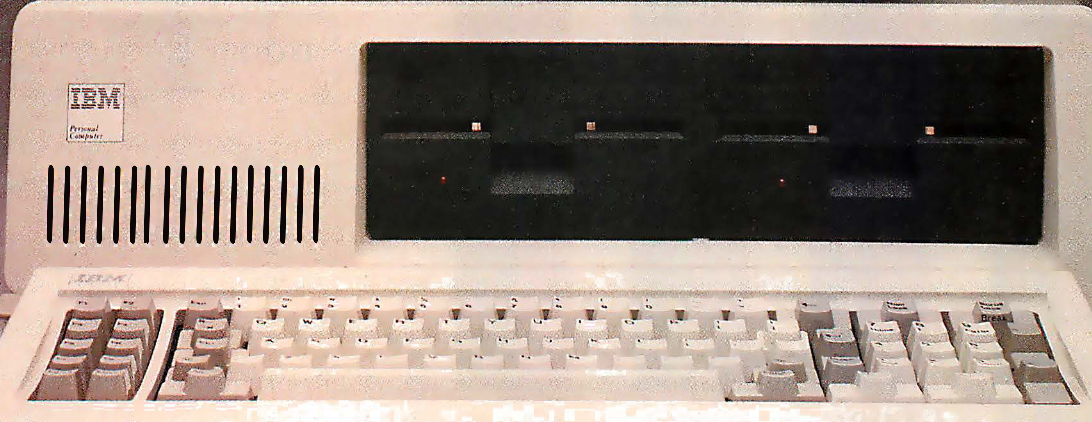
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ENHANCED CONSOLE DRIVER

BY ANTHONY ZACKIN

Create a user-friendly interface for DOS *with this* ANSI.SYS *replacement*

ONE OF THE most important functions of an operating system is to provide centralized support for I/O devices. When doing an input or output operation via the operating system, a program normally needs only to identify the device—the operating system then handles the details. For example, writing to the console and writing to a printer are similar and may, in fact, be performed by the same high-level language program statement, but from the operating system's point of view they are quite different. Consequently, to handle the differences between computer I/O devices the operating system must provide a set of routines called device drivers, usually one per device type, that handle the peculiarities of each device. These drivers are resident extensions of the operating system, which can call them as needed.

Versions 2.0 and later of MS-DOS and PC-DOS allow user-defined device drivers. You can define drivers to support new devices or replace existing DOS device drivers. An additional device driver for the console, which includes the keyboard and the display, comes in the DOS distribution package. This driver, ANSI.SYS, supports a subset of the American National Standards Institute cursor control sequences for terminal control. You can use these sequences, for example, to clear the screen, position the cursor, set display attributes such as foreground and background colors, and reassign the meaning of the keyboard keys.

REPLACING ANSI.SYS

I've written a complete replacement of the ANSI.SYS driver that provides the same functions and supports many more. I've also developed a utility to make programming the driver a simple matter. My driver, the Enhanced Console Driver (ECD), has a 2000-byte key definition buffer, which is almost seven times larger than that of ANSI.SYS. [*Editor's note: The* ECD *and associated files (CONDRV43.SYS, CU.EXT, README, AUTOEXEC.BAT, CONFIG-43.SYS, MENU25.BAT, STDKEYS.CU, CONDRV.DOC, MENU43.BAT, MENU-2.BAT, STDFKEYS.CU, and MENU.BAT) are available on disk and on* BIX. *See the insert card following page* 320. *Listings are also available on* BYTEnet. *See page* 4. *You will need an* IBM PC *or compatible with* DOS 2.0 *or later.*]

The ECD also provides for a more friendly user interface to the operating system. It does this by adding an on-screen clock with alarm, a Caps Lock, Num Lock, and Print Screen indicator, and the ability to define text windows, which may be displayed by either an application program or the operating system PROMPT command.

You control these functions in a manner similar to controlling ANSI.SYS—via special control sequences that start with an Escape character (ASCII value 27) followed by a left bracket ([, ASCII value 91). However, valid control sequences are never shown directly on the display device. The ECD examines all DOS output to the screen, looking for this sequence. If a control sequence is found, the ECD examines the remaining characters for a valid command and executes that command; otherwise, the output is displayed normally on the console.

Because device drivers become

(continued)

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resident extensions of DOS, you can issue commands to the ECD at any time. The only caveat is that you must execute the commands via the operating system so that the console driver recognizes them. Thus, you may execute the ECD commands in any program that updates the display through a DOS function call (interrupt 21H). Since there are many programs that avoid DOS for performance reasons, the ECD has the additional capability to support programs that do their console output via the system BIOS. However, programs that write directly to the display adapter are not supported by the ECD.

WINDOWS

Probably the most useful feature of the ECD is its ability to define windows in memory and then display them instantly on the console. One 80-column by 25-line text screen (4000 bytes, including 1 attribute byte per character) is available as a private screen buffer for storing windows. The ECD can also take advantage of the extra memory on the IBM Color Graphics Adapter (CGA). The CGA contains 16K bytes of memory of which only 4K are needed in the 80-column text mode. You may use the remaining 12K as three additional buffers to store more windows; unlike the ECD's private buffer, however, this 12K-byte area cannot be guaranteed across all program calls.

A window is nothing more than a set of four coordinates defining the upper left and lower right window corners relative to the display buffer. Each set of window coordinates in a buffer has a number, which you assign, and each buffer can hold up to eight windows. You place window text in a buffer by passing to the ECD a color attribute, a row and column coordinate, and a string of text. To display a window, you select the appropriate buffer and pass the window number to the ECD. The ECD instantly displays the window during the vertical retrace interval.

OTHER DISPLAY OPTIONS

You don't have to use the windows, however, to take advantage of the ECD's other features. The ECD can also display the current time anywhere on the screen and, if you have a color display, in any color. In a similar manner the ECD can display the seven-character (including spaces) string " C N P " to indicate the toggle settings for Caps Lock, Num Lock, and Print Screen—where the individual letters are displayed only when the corresponding setting is on.

The time display is a familiar hours-and-minutes format that you can easily move or switch on or off. For example, Lotus 1-2-3 version 1A does not display the current time, but with the ECD you could place the time display in, say, line 25 using the same colors as the other 1-2-3 status items.

(continued)

THE CU COMMAND SYNTAX

The following is a list of the commands supported by the Console Utility. Variables that you supply are indicated with variable words written in lowercase. Items in square brackets refer to optional fields; items separated by a vertical bar (|) indicate alternatives, one of which should be used. Bracketed fields followed by an ellipsis mean that zero or more occurrences of that field are acceptable; for example, [[attr] string] . . . means that any number of occurrences of a character string or a string preceded by an attribute or any combination thereof is valid.

An attribute represents the color or brightness of a character displayed on the console. It consists of two letters, one for the background color and one for the foreground color. A capital letter usually sets a blinking field for the background color and high intensity for a foreground color. Valid color values are w|W = white, b|B = black, u|U = blue, r|R = red, g|G = green, y = brown (Y = yellow), c|C = cyan, and m|M = magenta.

COMMANDS

@ row [,] col [attr] string [[attr] string] . . .

or

@ NEXTROW | NR [,] col [attr] string [[attr] string] . . .

locates text in the current buffer. If multiple attributes and strings are specified, they will be placed in the next buffer position following the preceding specified string. The row value should be between 1 and 25 inclusive, the column value (col) between 1 and either 40 or 80 inclusive depending on the current screen mode. If NEXTROW or NR is used instead of a row number, the number used will be equal to the row value of the previous @ command + 1.

ALARM [[AT | @] hh[:mm][xx] [[DISPLAY] [WINDOW] number]

or

ALARM [[AT | @] hh[:mm][xx] [[DISPLAY] [attr] string [[attr] string] . . .]

hh:mmxx represents the ASCII value of the time on a 12- or 24-hour clock; if the former, xx should be am or pm; if omitted, hours between 8 and 11 inclusive will be assumed am, all others pm. The window number should be a value between 0 and 7 inclusive. If a window number is specified, then every time the alarm sounds, that window in buffer ZERO is displayed. If a string is specified, then up to 80 characters of text will be placed in row 25 of screen buffer ZERO and assigned to window 7; this is equivalent to issuing the three commands ALARM hh:mmxx 7; DEFINE WIND 7 AS 25,1 THRU 25,80 AT 24,1; @25,1 attr "This is the message text." Note that the message is placed in line 25 of the buffer but is displayed in line 24 because the latter is less likely to contain system status information. The alarm will sound approximately every 30 seconds until explicitly reset; this may be done by typing CU ALARM RESET or more simply by pressing both the left and right Shift keys simultaneously (this will also reset a pending alarm). If no arguments are specified, the alarm will be sounded once.

ALARM RESET
turns off a currently ringing or pending alarm.

BIOSTRAP OUTPUT | NONE
OUTPUT means that output operations to the console via the BIOS will be trapped; that is, programs that bypass DOS calls using direct BIOS calls instead may issue console driver commands via their escape sequences. NONE means that BIOS call trapping will be turned off if set.

(continued)

BUFFER number
sets the current buffer: number should be a value between 0 and 3 inclusive; default = 0. All subsequent commands affecting a buffer, namely, @, CLEAR, DEFINE, and DISPLAY, will use this buffer until it is explicitly reset.

CLEAR [attr] row [,] col [THRU | THROUGH] row [,] col
clears a portion of the current buffer and resets its attribute bytes.

CLEAR EOL
"clears" from the current position to the end of that line by filling it with blanks using the last specified attribute. (The current position is the location in the buffer immediately following the last character written by the @ command.)

CLOCK [attr] [BLINK] [SUPPRESS number] [[AT | @] row [,] col]
displays the time as hh:mmxx (xx=am/pm) at the specified location. The row value should be between 1 and 25 inclusive, the column value (col) between 1 and either 40 or 80 inclusive depending on the current screen mode. BLINK determines whether the colon will blink. SUPPRESS will suppress the next *number* clock calls so that this call may be effective even though a subsequent call to display the clock is made via the system PROMPT string; a value of 255 will keep the clock off until a subsequent CLOCK SUPPRESS call with a value < 255 (e.g., 0). If the [AT row,col] specification is omitted, the time will not be displayed until the next CLOCK command with an AT row,col parameter. If the CLOCK is not set by the PROMPT string, then typing CLOCK alone turns off the display; if the CLOCK is set by the PROMPT, use CLOCK SUPP 255 to temporarily turn off the display.

CLOCK DISABLE
releases all control of the system clock and is useful to enable other programs to get control of the clock interrupt; the next CLOCK call without the DISABLE option will reenable control of the system clock. CLOCK DISABLE can be used to temporarily give up control of the system clock to allow a timer-sensitive application to get precedence. Control of the system clock is initially disabled.

DEFINE [WINDOW number] [AS] row [,] col | [THRU | THROUGH] row [,] col [AT | @] row [,] col
defines a window (default is 0) in the current buffer for a subsequent display. The row values should be between 1 and 25 inclusive, the column values (col) between 1 and either 40 or 80 inclusive depending on the current screen mode. The AT parameters refer to the location on the screen where the window will be placed.

DISPLAY [WINDOW number]
immediately displays the specified window (0 if omitted) of the current buffer. This command may also be used as the redefinition value of a key.

EXIT
takes you out of the CU program (needed only in the interactive mode).

HELP [PRINT] [string]
HELP string displays a summary of all commands whose names start with the specified string; commands include @, ALARM, BIOSTRAP, BUFFER, CLEAR, CLOCK, DEFINE, DISPLAY, EXIT, LOCKS, READ, STACK, or KEY for key redefinition information. If HELP ALL or HELP PRINT ALL is specified, the full document is listed or printed. If PRINT is specified, the output will be directed to the printer.

KEYDEF SUPPRESS number
KEYDEF SUPPRESS n will set the DOS keyboard redefinition suppress count: 0 = interpret redefinitions, 1–254 = suppression count. Keyboard redefinition should be suppressed prior to running programs that use DOS I/O and need to read the keys you have redefined for DOS. KEYDEF SUPPRESS 255 will

(continued)

decrement the keyboard redefinition suppress count if it is nonzero (i.e., keyboard redefinition has been suppressed); KEYDEF SUPPRESS −1 may be specified instead for clarity. This corresponds to Esc[136;255:, which normally should be part of the system prompt as $e[136;255: to explicitly decrement any nonzero redefinition suppress count. Note that this suppression count should be 1 greater than the count used in the other commands (e.g., CLOCK), since the count will be decremented explicitly by the system prompt prior to the use of any redefined key.

LOCKS [attr] [SUPPRESS number] [[AT | @] row [,] col]
displays the current toggle status for Caps Lock, Num Lock, and Print Screen (set/reset via Ctrl-PrtSc or Ctrl-P). SUPPRESS will suppress the next *number* lock display calls so that this call may be effective even though a subsequent call is made via a user-defined PROMPT string; a value of 255 will keep the locks off until a subsequent LOCKS SUPPRESS call with a value < 255 (e.g., 0). The row value should be between 1 and 25 inclusive, the column value (col) between 1 and either 40 or 80 inclusive depending on the current screen mode. If the AT row,col specification is omitted, the lock display will not be displayed until the next LOCKS command with an AT row,col parameter. If the LOCKS are not set by the PROMPT string, typing LOCKS alone turns off the display; if the LOCKS are set by the PROMPT, use LOCKS SUPP 255 to temporarily turn off the display.

LOCKS DISABLE
releases all control of the keyboard and is useful to enable other programs to get control of the keyboard interrupt; the next LOCKS call without the DISABLE option will reenable control of the keyboard. LOCKS DISABLE can be used to temporarily give up control of the keyboard to allow a keyboard-sensitive application to get precedence. Control of the keyboard is initially disabled.

MODE screen-size-number [SUPPRESS number]
screen-size-number should be 25 or 43. MODE 43 sets the number of screen lines to 43 for use with the Enhanced Graphics Adapter or equivalent. MODE 25 resets the number of lines per screen to the standard value. SUPPRESS will suppress the next *number* mode calls so that this call may be effective even though a subsequent call is made via a user-defined PROMPT string; a value of 255 will disable subsequent MODE calls until one with a SUPPRESS value < 255 (e.g., 0) is issued. (The console driver window buffers are still limited to 25 lines even in 43-line mode.)

READ [device:][path]filename [,[device:][path]filename] . . .
accepts CU input from the specified file or files. This command can be specified only from the parameter string or the keyboard; that is, a READ file cannot contain another READ command.

STACK string
puts the specified string at the end of the DOS keyboard input buffer. This command is useful for providing a predefined response for applications that use DOS commands to read keyboard input. READ should be either the only command or the last command in a file processed by CU READ since it causes CU to terminate.

The ECD clock also includes an audible alarm. The alarm has a distinctive sound, which you can use in lieu of the standard bell, for example, to signal the end of a batch file. Or, of course, you can set the alarm for a specific time. You can even have a text window display a message on the console when the alarm goes off. (If the alarm goes off when the display is in graphics mode, the text window will not be legible.) Once activated, the alarm will continue ringing until you turn it off by issuing a command sequence to the ECD or by pressing both Shift keys at once. In the latter case the ECD sounds two beeps to indicate the alarm has been reset.

For systems with an IBM Enhanced

(continued)

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Programming the Keyboard

In addition to the standard, typewriter-like keys on the keyboard, you can also redefine any of the special keys listed below. All names preceded by an A, C, or S refer to the concurrent typing of the Alt, Ctrl, or Shift keys respectively—except for names beginning with CU, which refers to the arrow (cursor) keys on the numeric keypad. For example, CULE is the cursor left (arrow) key; CCULE is that key plus the Ctrl key; A1 is the 1 key plus the Alt key; SF1 is the Shift key plus the F1 key, etc. Some of the keys can be specified in more than one way, for example, CCULE or CCURSORLEFT. These special key names may also be used in the redefinition string to reset a special key to its original value. You should not use quotation mark delimiters when entering these key names.

A–, A0, A1, A2, A3, A4, A5, A6, A7, A8, A9, A=, AA, AB, AC, AD, AE, AF, AF1, AF10, AF2, AF3, AF4, AF5, AF6, AF7, AF8, AF9, AG, AH, AI, AJ, AK, AL, AM, AN, AO, AP, AQ, AR, AS, AT, AU, AV, AW, AX, AY, AZ, BACKTAB, CCULE, CCURI, CCURSORLEFT, CCURSORRIGHT, CEND, CF1, CF10, CF2, CF3, CF4, CF5, CF6, CF7, CF8, CF9, CHOME, CPAGEDOWN, CPAGEUP, CPGDN, CPGUP, CPRTS, CPRTSC, CUDN, CULE, CURI, CURSORDOWN, CURSORLEFT, CURSORRIGHT, CURSORUP, CUUP, DEL, END, F1, F10, F2, F3, F4, F5, F6, F7, F8, F9, HOME, INS, PAGEDOWN, PAGEUP, PGDN, PGUP, SF1, SF10, SF2, SF3, SF4, SF5, SF6, SF7, SF8, SF9, STAB

Examples

To define the key combination Alt plus function key F1 so that it changes the current directory to one named WP and invokes a program named WORD, you could use any of the three following statements (the Enter key can be represented by either ~013 or }):

AF1 CD\WP~013WORD~013

AF1 "CD\WP ~013 WORD ~013"

AF1 CD\WP}WORD}

To undefine (return to its original state) the key combination Alt plus function key F1, use AF1 AF1.

Graphics Adapter or equivalent the ECD provides 43-line support. This feature is useful primarily for certain DOS operations, but you can also use it with programs that are easily modified, such as WordStar 3.3, to take advantage of the additional display lines. Most DOS commands, unfortunately, expect a 25-line display, but many, such as MORE, for example, can be patched to work with 43 lines. Others, including DEBUG, work great in the 43-line mode. Switching between 25- and 43-line modes is easy.

Displaying Menus from the PROMPT Command

Because the DOS PROMPT command can send an escape character to the console via a special meta string ($e), you could use PROMPT to completely control the ECD. This means that every time your computer would normally display the standard system prompt, the ECD can automatically display one or more windows. Such an ability lets you easily create a shell screen for DOS. For example, you can have help information or menus appear on the screen—in effect, just a fancy system prompt—and you can still issue all DOS commands normally.

When used with its key assignment feature, the ECD even lets you invoke a program with a single key. Thus, the prompt menu could list each program and the associated key or key combination that invokes it. When you terminate the program, the PROMPT command also ensures that a new menu is displayed; that way, you always know what programs are available and how to run them.

Programming the ECD

As with ANSI.SYS, the native ECD command syntax extensions were designed for computers, not for people. For example, to put a red-on-white "HELLO" followed by a magenta-on-black "THERE" in the first positions of a memory buffer, you would have to send the following escape sequences to the ECD (where Esc refers to the 1-byte value of the escape character, ASCII value 27):

```
Esc[2;116;1;1;"HELLO":
Esc[66;5;"THERE":
```

You could issue the sequence from a file using the DOS TYPE command (assuming the file contains embedded escape values) or an ad hoc program, which might translate every occurrence of $e to an escape character, or you could simply use the system PROMPT command. In any case, the syntax is unwieldy and certainly hard to remember.

Hence I developed the Console Utility (CU)—a program that accepts less cryptic commands for controlling the ECD functions. In general, with the help of the CU you have to use native ECD commands only for functions controlled by the system prompt. Otherwise, the CU provides a much easier way to issue ECD commands either directly on the DOS command line or as part of a batch file. It also provides help information for all the commands as well as general information about how to use the program. (Type CU HELP ALL for a full list of commands and options.) See the text box "The CU Command Syntax" on page 185.) If the CU is run without command parameters, it will prompt you for commands with a question mark.

When issuing CU commands from a batch file, you can specify an entire set of commands by separating the commands with semicolons. One of the CU commands, READ, enables the CU to read and interpret one or more command files; consequently, you can create complicated window definitions with just one call of the CU program.

(continued)

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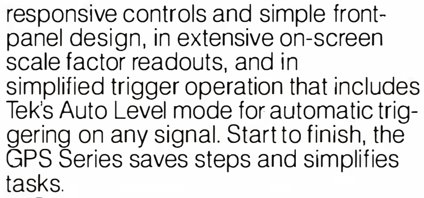
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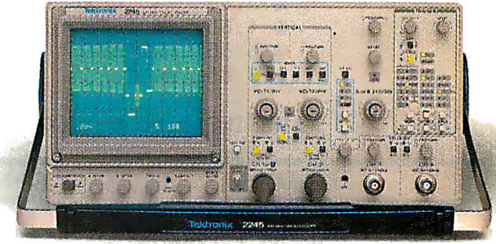


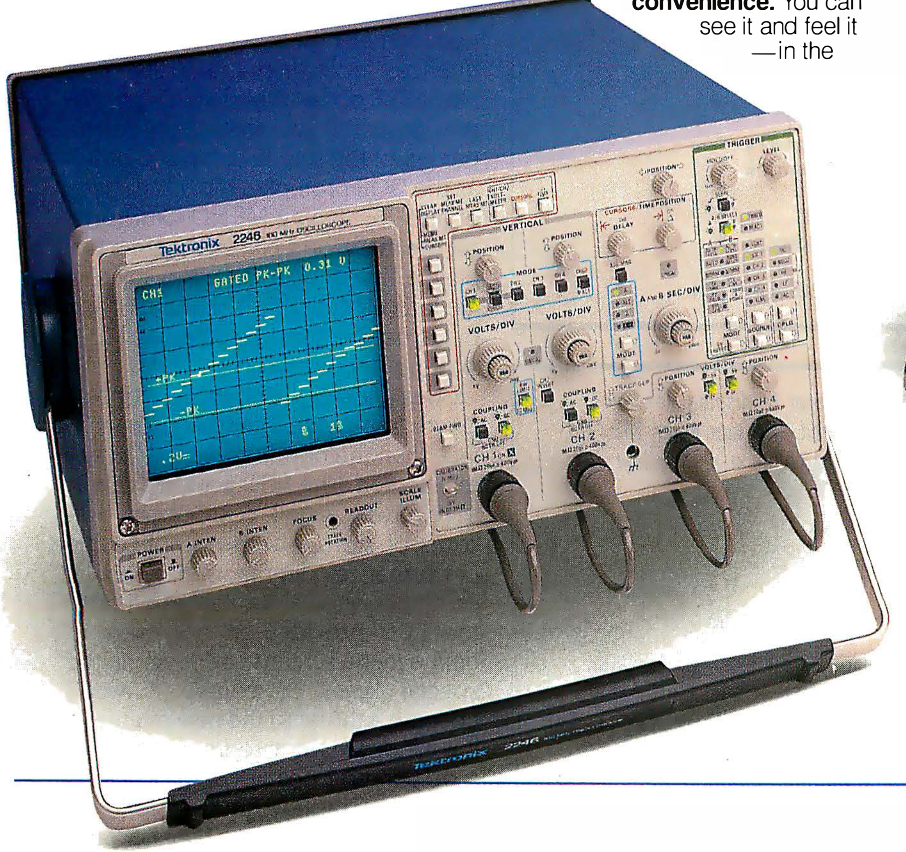
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KEY ASSIGNMENTS

The CU also provides an easy method to redefine the keyboard. You can assign a character—letters, digits, special characters such as ~, !, /, ?, and so forth—to any of the single-character keys (the white keys in the center of the keyboard) or to a combination of keys.

To redefine a key you need only specify that key in quotation marks, followed by a space and the new definition string of characters, which needs to be delimited by quotation marks only if the string contains embedded spaces. You can specify any ASCII character with a tilde (~) followed by the three-digit ASCII value of the keystroke. You can represent the Enter key either by the closing brace character (}) or by ~013. In addition to the standard, typewriter-like keys on the keyboard, you can also change assignments for any of the keys listed in the text box "Programming the Keyboard" on page 190.

You can also display a window with an appropriately designated key or combination of keys, such as Ctrl-Home. To display window 1, for example, every time the Ctrl-Home key combination is pressed, specify CHOME DISPLAY WINDOW 1.

Listing 1: *A sample CU command file that creates a menu and redefines associated keys. To execute the file, you should place the line* CU READ STDFKEYS.CU *in the* AUTOEXEC.BAT *file. In addition to the standard* ANSI.SYS*-type sequences that control the display colors used by* DOS *and the cursor position, all other* ECD *functions are accessible from the prompt string using the* $e *specification to represent an escape character.*

```
STDFKEYS.CU

AF1     "CU LOCK SUPP 2 @ 25 67;CLOCK SUPP 2 @ 25 74}
 CD\XTALK}XTALK}"
AF2     "CU LOCK SUPP 2;CLOCK SUPP 2}CD\FW}FW}
AF3     "CU LOCK SUPP 2;CLOCK cb BLINK SUPPRESS 2 @ 25 35}
 CD\LOTUS}123}"
AF4     CD\DBASE}DBASE}
AF5     "CU KEYDEF SUPP 3}CD\ROL}ROLODEX}"
              @ 1,64 wr  " ________________ "
              @ 2,64 wr  "|                |"
              @ 3,64 wr  "|                |"
              @ 4,64 wr  "|                |"
              @ 5,64 wr  "|                |"
              @ 6,64 wr  "|                |"
              @ 7,64 wr  "|________________|"
              @ 2,65  mW "aF1 " cW " Crosstalk "
              @ 3,65  mW "aF2 " cW " Framework "
              @ 4,65  mW "aF3 " cW " 123       "
              @ 5,65  mW "aF4 " cW " dBASE     "
              @ 6,65  mW "aF5 " cW " Rolodex   "

              DEFINE WIND 0 1,64 THRU 7,80 AT 1,64
```

Listing 2: *This sample batch file sets the system prompt to display window* 0 *of the private buffer. Once the batch file has been executed, you can enter* MENU ON *or just* MENU *at the* DOS *command prompt to create a new system prompt that will display the menu created by listing* 1.

```
MENU.BAT

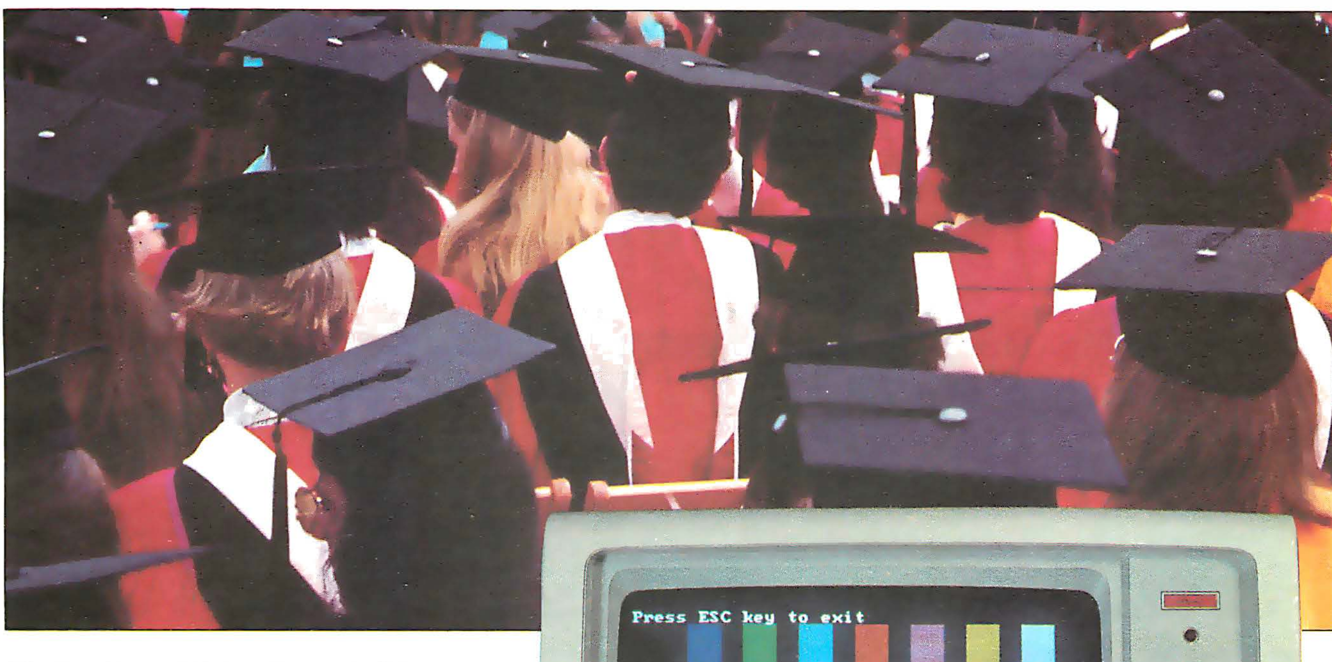
echo off
if .%1 == .off goto OFF
if .%1 == .OFF goto OFF
rem
rem Set menu ON
rem
PROMPT $e[136;255:$e[10:$e[128:$e[1;31;40m$e[1;1H$p$e[14;206
 ;1;67:$e[76;14;1;74:$e[37;44m$e[25;1H$e[K$g
goto DONE
:OFF
PROMPT $e[136;255:$e[2A$e[s$e[14;206;1;8:$e[76;14;1;1:$e[1;
 15H$e[K$e[31;40m$p$e[0;1;37;44m$e[K$e[u$e[B$g
:DONE
```

CREATING A PROMPT COMMAND TO DISPLAY THE MENU

To create a menu display you can use the CU input file like the one in listing 1. Once the CU file has been processed, you can turn the menu display on or off by creating a new system prompt with a batch file like the one in listing 2, which sets the system prompt to display window 0 of the private buffer. After that batch file has been executed you can type MENU ON (or just MENU), and from that point on, the ECD will display window 0 of the private buffer in its designated position; the key toggle settings and the time will appear in the upper right corner. (The remainder of the sequences in listing 2 are standard ANSI.SYS codes that display the current drive and subdirectory in the upper left of the screen and place a ">" as the DOS prompt in the first column of line 25.) Typing MENU OFF turns off the menu and places the time display at line 1, column 1, the key toggle indicators in line 1, column 8, and the current device, directory, and ">" starting in column 15.

I designed the Enhanced Console Driver to provide a simpler user interface than the normally terse DOS system screen. The ECD achieves this at a relatively small cost—about 10K bytes of storage with no noticeable performance degradation. And in combination with the Console Utility the ECD provides an easy way to define menu screens and redefine the special keys. Of course it won't become a threat to the new multitasking windowing environments, but for anyone who does not want to invest the extra money and system resources in one of those sophisticated commercial programs, the ECD is a useful tool. ■

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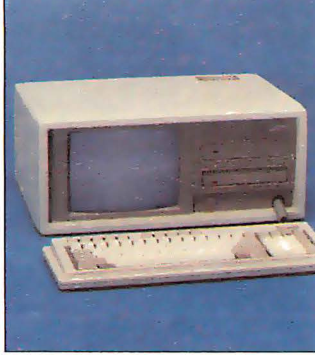
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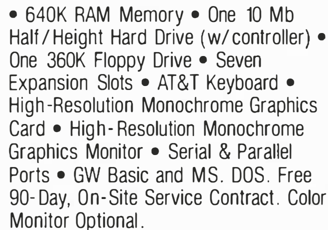
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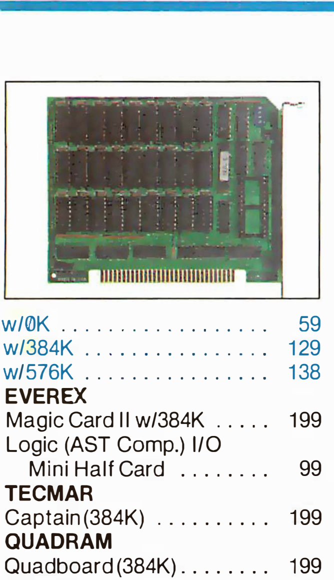
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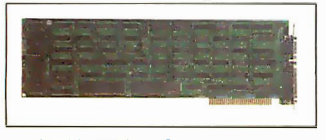
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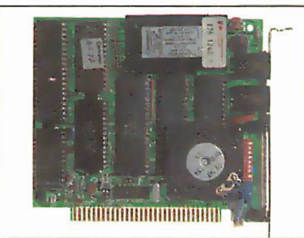
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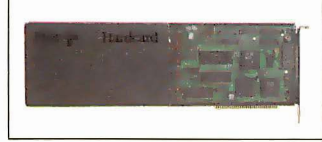
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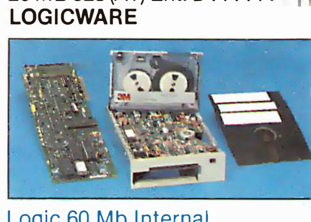
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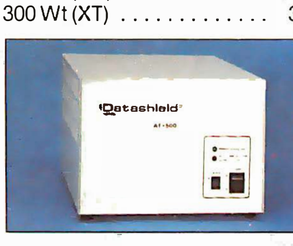
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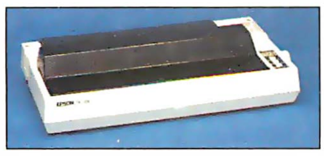
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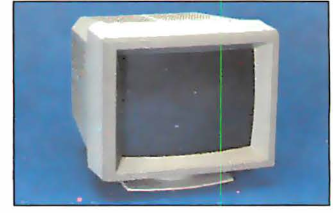
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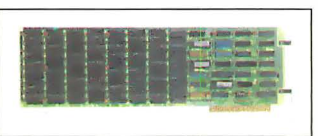
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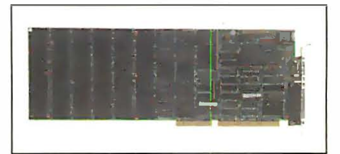
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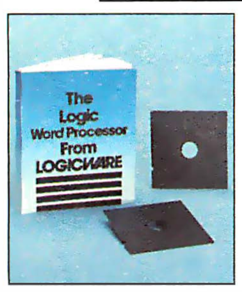


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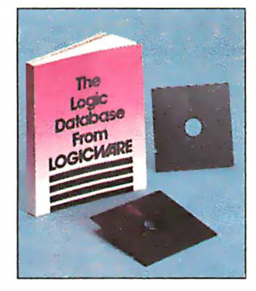
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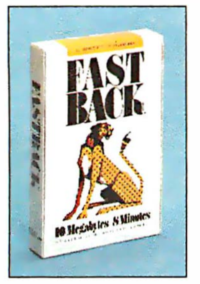
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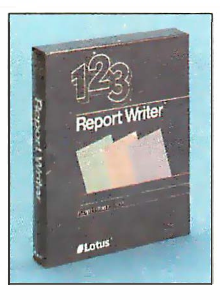
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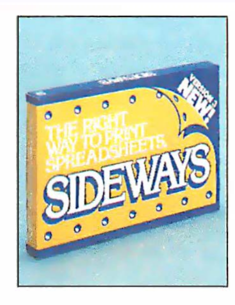
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ABUNDANCE

BY ROEDY GREEN

A database language that can run backward in time

ABUNDANCE IS a public domain, FORTH-based, data-entry, database, screen-handling language that automatically handles the routine "housekeeping" that accounts for a major part of interactive application code. It does not use artificial intelligence techniques; it simply performs these tasks as a side effect of the work you explicitly ask it to do. If you want to take control of any of these tasks yourself, you can.

Abundance was originally designed to serve charities working to create an *abundance* of food, water, and shelter on the planet; hence, its name. But because of its features, it has become a business programming language and has been used in production environments since 1981. Although Abundance was designed for the computer-naive volunteer worker, it is responsive enough for a business environment.

[*Editor's note: The Abundance package of 15 disks includes source code in* IBM *Backup/Restore format for Abundance itself, a 32-bit* FORTH *compiler, a postfix assembler, a screen editor, some sample applications, documentation, tutorials, and more. Since it is too large for* BYTE *to distribute, it is available only by mail for* $75 U.S. *cash, check, or money order (the cost of duplication) from the author at his address.*]

A RICH LANGUAGE

Abundance is a rich language with 600 verbs of its own, 400 from Forth-83, 300 from assembler, and 900 hidden ones. It can open files, validate data entry, convert values back and forth between binary and ASCII, keep track of how many elements in an array are in use, read from and write to disk, and lay out fields in columns on an appropriately labeled screen—all without being explicitly asked.

If you recompute a variable currently displayed on the screen, Abundance, like a spreadsheet, automatically refreshes the screen with the new value. It understands the zip code system, the telephone numbering system, and the states of the union and can cross-check all three; it can perform similar cross-checks for other countries as well. Abundance knows that phone numbers need a dash in the middle and that area codes are enclosed in parentheses. It also knows that 555-1212 is not the phone number of any real person. It knows the calendar; it knows that 1900 was not a leap year and that 2000 will be. And it knows that the people in India use the date format DD/MM/YY while Swedes use YY.MM.DD. Most important, however, Abundance takes the initiative and uses this knowledge without your having to explicitly ask for it.

Abundance also understands the limitations, quirks, and control sequences of at least 20 brands of printer. It lets you think that you have the perfect printer, one that can print in any pitch, any type style, and any of the 256 accented and special characters. You can use words like ITALIC, BOLD, and WP-QUALITY, and Abundance will do the best it can with your actual printer. It can also number your pages 1 of 20, 2 of 20, etc.

Abundance can speak in English, French, Swedish, or Esperanto, and you can key all the accented characters without resorting to the numeric keypad. It can also interface with other packages, including Btrieve, Lotus 1-2-3, VP-Planner, Microsoft

(continued)

Roedy Green is president of Canadian Mind Products (11-3856 Sunset St., Burnaby, BC, Canada V5G 1T3). He has a B.S. in mathematics from the University of British Columbia.

Word MailMerge. Ready!, Optimum Data External Sort. SuperKey, and ProKey.

In addition to its main features, Abundance has many other novel features with colorful names like humps, jives, combos, anchors, gauntlets, living fields, fast forwards, variable variables, moods, promises, safes, riktnummers, and graceful bailouts.

THE USER INTERFACE

Because Abundance is a superset of both 8086 Assembler and 32-bit Forth-83 and because the hidden verbs that form the language itself are available to you, you can interface with it at any level you choose.

When you use Abundance, you see a traditional full-screen arbitrary layout, often in columns or rows with boxes, color, and data labeled with the appropriate variable names. Each time an Abundance application expects you to key in data, it highlights the field in reverse video and puts an oversized blinking cursor on the first character of the field. It then produces a uniform prompt message containing the name of the variable being keyed, its upper and lower acceptable bounds (or a list of choices), what sort of data it wants (name, date, etc.), and usually some other explanatory information. In addition, Abundance maintains the Caps Lock, Shift, and Num Lock keypad indicators.

You can use the backspace, arrow, and function keys to edit the data in such a way that they mimic your favorite word processor. If you get lost, you can hit the Oops key (the F10 function key) to put the field back the way it was. Abundance usually detects any errors in keying as soon as you make them. It makes various sounds for different classes of warnings and errors that indicate immediately what you did wrong. Abundance works in the background, inserting the Shift key when you forget to, jumping over the dash in a phone number, and keeping numbers right-justified (calculator-style) as you enter them.

If you realize you made a mistake in a prior field, you can hit the up arrow to make the program "run backward in time." Then you can enter a new value for the prior field and use the down arrow to carry on where you left off. You can also hit the Escape key at any time. In general, this stops the application in an orderly fashion so that files are kept logically consistent and no data is lost.

JAUNTING

Jaunting is the ability to run backward in time. It is simply a streamlined version of the IBM OS/370 checkpointing facility. When you key in a field, Abundance secretly takes a "snapshot" of the *state* of the application program. When you hit the up arrow, it finds the appropriate old snapshot of the application and restores it to the current view. The application then carries on as if it had never been any further than that.

Jaunting has no perceptible overhead. It is quick because you don't need to save all of RAM, just the data stack, the return stack, and a few critical internal-state variables. As in FORTH, the data stack holds temporary variables and parameters passed to procedures, and the return stack keeps track of which procedure called which procedure.

Surprisingly, the values of the variables are not saved as part of the snapshot. If Abundance did save the variables and then restored them to the old state after jaunting backward, you would lose the data you had entered since then. When the application program wakes up after its jaunt, the values of the variables keyed just prior to jaunting are intact. You might think it would confuse the program to find the variables it is about to request already present, but in practice this rarely causes any problem.

MUSTs AND WARNs

Jaunting has some wonderful fringe benefits. For instance, an Abundance

(continued)


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application can assert that a certain expression *must* be true, for example, that three fields must add up to 100 percent. If the program detects that a MUST has failed, it jaunts the program back to the first input involved. As a programmer, you can optionally provide hints as to which field you think is wrong, but even if you guess wrong, the end user can hit the up and down arrow keys to correct the real culprit.

There is also a variant of the MUST called the WARN that makes an "eh?" noise—I *am* Canadian—and asks you to confirm that an unusual condition is indeed correct. If you answer "No," the program jaunts backward the way a MUST would.

Implicit Array Subscripts

In traditional programming languages, for every array you declare, you must also declare three other variables: ArrayMax, the maximum size the array can be; ArrayHighWater, the number of array slots currently containing data; and ArrayIndex, the array element you are currently working on. Then you refer to Array[ArrayIndex] over and over again. You rarely use any other subscript. When you do, it's usually by mistake, and you spend a long time trying to find the bug in your program. In addition, you must manually maintain ArrayHighWater and make sure that ArrayIndex stays safely within bounds. And you must explicitly mention ArrayIndex and ArrayHighWater every time you loop through the array elements—yet another place for bugs to creep in.

Abundance dispenses with all but the array index. It invisibly maintains ArrayHighWater and ensures that the index remains within bounds. You don't need to write [ArrayIndex] each time; it is assumed. And you don't need to mention anything other than the array index in a <<<FOR loop since Abundance keeps track of the array's upper limit.

You can convert a program that handles a single record to one that handles an array of records simply by changing the declaration. You don't need to change any procedural code; you need only add one line of code to set the implicit subscript. (The

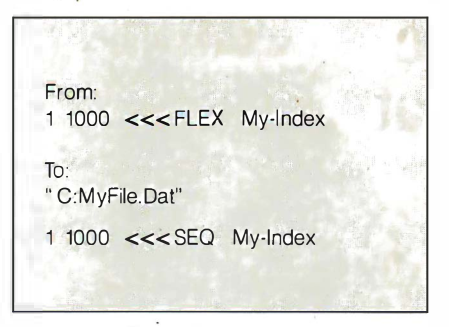


Figure 1: *The only change necessary to convert a program from one that keeps its data in an array to one that keeps it in a file.*

equivalent changes in Pascal would require modifying a great many lines of code.)

File Handling

To an Abundance application, a file is simply a large array, too large to fit into RAM. You read and write the records by changing the implicit array subscript that indexes the record you want to work on. Abundance automatically handles blocking and deblocking, reading, writing, opening, closing, caching, and "dirty" bits. It does everything it can to avoid doing physical disk I/O. It handles standard DOS files with fixed-length records, but it also has other higher-performance options.

You can convert a program from one that keeps its data in an array to one that keeps it in a file by changing the word <<<FLEX in the data definition area to <<<SEQ and adding an external DOS filename (see figure 1). (The equivalent change to a Pascal program would require almost a complete rewrite.)

Scaffolds

There never seems to be enough room on the screen to simultaneously display everything you would like to show. You may only have room to show the details of four transactions when you would like to show 40. The ability to scroll lets you show any of the 40 that you want, four at a time. In traditional languages, handling this scrolling can be very complex.

In Abundance, scaffolds come to the rescue. You simply write the name of a particular scaffold in the declaration of a variable array element. A scaffold might have a name like 2x6 for two rows of six columns or 4Deep for rows with a maximum of four elements. From then on, Abundance monitors the implicit subscript of the array. It makes sure that the current element is always visible on the screen. As the subscript changes, Abundance scrolls the display automatically so you can always see the current, some preceding, and some succeeding elements in the array.

Other than in the declaration, the application code is totally oblivious to this scrolling. Abundance makes sure that the array element you are keying or computing is always visible. In addition, scaffolds can take any shape you can describe; they don't need to be simple rowed windows.

What You Need

To experiment with Abundance, you need MS- or PC-DOS 3.1 running on an IBM PC, XT, AT, or a close clone. You need at least 320K bytes of RAM and a hard disk. The applications you write can run on floppy disk systems, however.

You need to know FORTH. I recommend practicing with a 16-bit FORTH compiler using Leo Brodie's book *Starting FORTH* (Prentice-Hall, 1981) if you are currently unfamiliar with the language. Sooner or later you will probably want an assembler to generate customized versions of the BBL FORTH compiler and a text editor to edit the assembler source code. Depending on how you use Abundance, you may also want other packages, such as a keyboard enhancer, an external sorter, a B-tree handler, a form-letter generator, or an automatic means of transferring a database into Abundance.

What You Get

Abundance and its documentation come on floppy disks in IBM Backup/Restore format. You are strongly encouraged to copy the disks and give them to your friends. There is only one restriction on how you may use the package: You may not use it for any military purpose. You are welcome to create your own dialects of Abundance, sell it, or cannibalize it. ■

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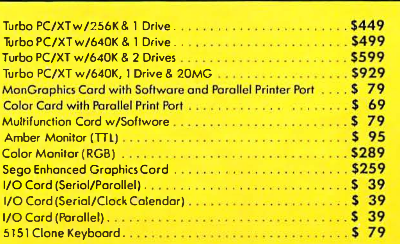
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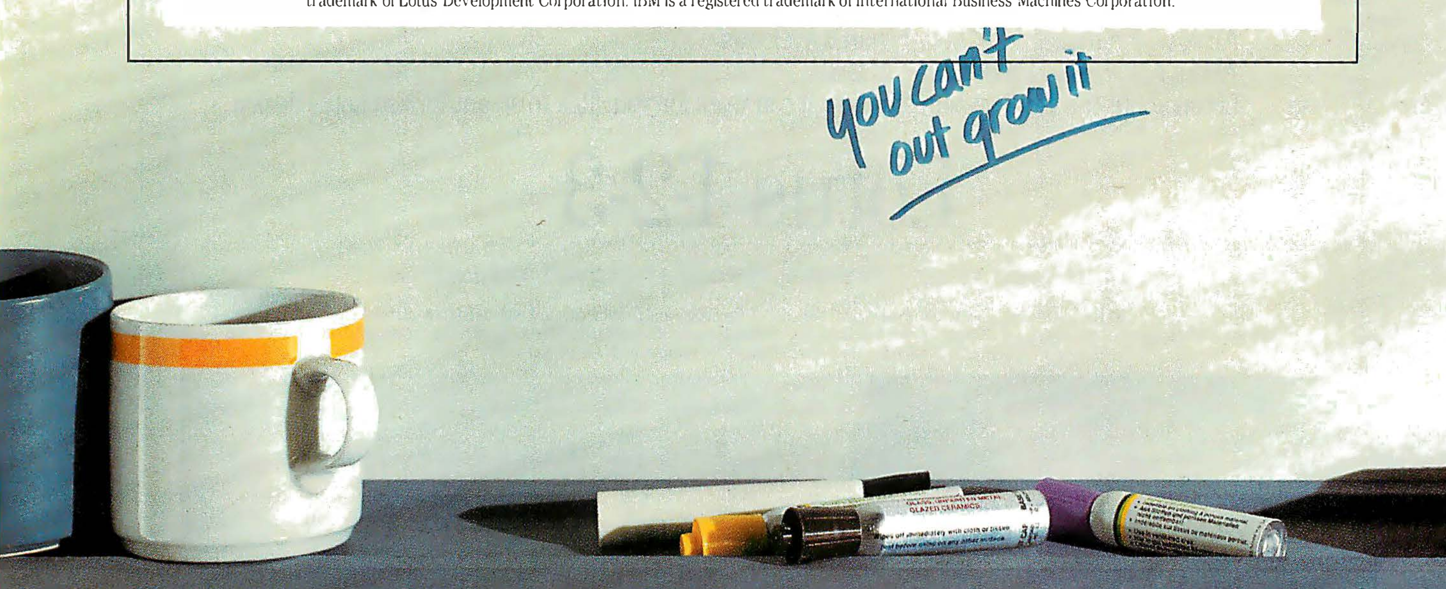
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Z80MU

BY ROBERT A. BAUMANN

This program for the IBM PC *emulates the Zilog* Z80 *and* CP/M 2.2

Z80MU ("the Emulator") runs on the IBM PC and emulates the Zilog Z80 processor and CP/M 2.2. It can be used as a Z80 development system whether or not the final Z80 code is designed to run under CP/M. The Emulator requires PC-DOS 2.0 or higher. While memory requirements vary depending on which Emulator facilities you use, if a CHKDSK of your system shows at least 256K bytes of free memory, you have room to run the Emulator. Computerwise Consulting Services developed the Emulator and decided to release it to the public domain for three reasons: it's good advertising for the work we do, we've benefited from public domain software in the past and this is one way to return the favor, and we get the benefit of hundreds of testers. [*Editor's note: The executable code for the* Z80MU *runs on an* IBM PC. *The archive file* Z80MU310.ARC *contains six files, including the emulator and a user's guide. See the insert card following page* 320 *for details. The programs are also available on* BYTEnet; *see page* 4.]

The heart of the Emulator is a carefully coded "Z80 engine" (written entirely in 8088 assembly language) that emulates Z80 op codes, the CP/M BIOS and BDOS functions, and a VT52 terminal for full-screen CP/M applications (e.g., WordStar, dBASE II, etc.).

Around the Z80 engine is a whole lot of high-level code (written in Lattice C) that provides the user interface, debug commands, PC-DOS interface commands, a full Z80 disassembler and RESOURCE facility, and environment control.

HOW ACCURATE AN EMULATION IS IT?

The Emulator's Z80 engine emulates the Z80 almost perfectly, down to an emulation of all six flag bits in the flags register. Even the seldom-used half-carry and add/subtract flag bits are emulated. But for faster execution, the Emulator ignores the two unused bits in the flags register, so these will not act exactly as they would on a real Z80.

I/O instructions (the INs and OUTs) perform everything except the actual strobe of the I/O data lines. The data transfer has been disabled because it is dangerous to have Z80 code accessing I/O addresses that mean something entirely different on the IBM PC. But setup, auto-increment of registers, and flag effects have been emulated even for the INs and OUTs.

We took a less precise approach when emulating CP/M 2.2. We wanted to keep the interface close to CP/M's but weren't interested in emulating the limitations of CP/M. We wanted to include many of the benefits of PC-DOS and to add many more built-in commands than were available with CP/M. We also demanded the largest possible Transient Program Area (TPA—the amount of memory available to be used by a Z80 program).

So we decided to support only "well-behaved" CP/M applications. A well-behaved CP/M program is one that accesses the disk via CP/M's file BDOS functions and doesn't look too closely at the reserved fields of the file control block (FCB). It doesn't use the Z80 IN or OUT instructions. It performs device I/O (to the screen, the printer, etc.) via BIOS or BDOS calls.

The program interface (via the BIOS and BDOS) is exactly the same as CP/M's. Some BIOS and BDOS func-

(continued)

Robert A. Baumann, the owner of Computerwise Consulting, writes custom software for the IBM PC, *mostly in assembly language and* C. *He can be contacted at* P.O. Box 813. McLean, VA 22101.

tions that are hardware-specific—or expect disks to have the CP/M format—are not supported.

The handling of commands and command arguments (the command "tail") appears to the Z80 application exactly as it would on a real CP/M system. The default FCB at 005C is formatted with the filename implied by the first command-line argument, and the FCB at 006C with the second argument. (All addresses are hexadecimal unless otherwise noted.) The byte at 0080 is set to the number of characters in the command tail and is followed by an uppercase version of the command tail as typed by the user. The Emulator has a TPA of 65,022 bytes, more than is available on most "real" CP/M systems.

We built a pseudo VT52 terminal into the Emulator, since many CP/M applications (especially those doing full-screen editing) assume that they are being run from a serial ASCII terminal. A list of some of the CP/M applications that we have successfully run is shown in table 1.

WHAT WON'T RUN UNDER THE EMULATOR?

Some hardware-specific CP/M programs cannot be run under the Emulator or must be run carefully to avoid functions that examine the hardware environment. STAT.COM, for instance, interrogates the physical layout of the disk and interprets it as if it were formatted for CP/M. Since PC-DOS disks aren't in CP/M format, STAT is immediately aborted by the Z80 engine. WordStar's SpellStar won't work, either. It tries to call CP/M's console command processor (CCP) within the 64K-byte CP/M segment. In the Emulator, however, there *is* no CCP in the CP/M segment.

Some CP/M programs look too closely at the "reserved" fields of the FCB and thus ought not to be emulatable at all. We have added special code to the Z80 engine that tries to keep the FCB looking as though it was being manipulated by CP/M, not PC-DOS.

MOVING CP/M PROGRAMS TO THE IBM PC

There are two ways to transfer a CP/M program to a PC-DOS file format. The first is to use a PC-DOS utility that runs on the IBM PC and is capable of reading the foreign CP/M disk format. Two such utilities are Convert (from Selfware Inc., Fairfax, Virginia) and Xenocopy (from Vertex Systems Inc., Los Angeles, California). This approach is nice, but only certain disk formats are recognized by each of these utilities. Apple II CP/M and North Star Horizon CP/M disks, for example, cannot be read on the IBM PC without special hardware.

Another approach is to transfer the CP/M files to the IBM PC via a communications line. If you have a CP/M system and an IBM PC, you can directly connect the two machines' serial ports and transfer files at 9600 baud. Otherwise, you can make the transfer over the phone at whatever speeds the respective modems can handle. In either case, the CP/M system (running BYE and XMODEM/MODEM7) sends its files to the IBM PC, which may be running any of the public domain communications programs that support the XMODEM protocol. The major advantage of this approach is that you don't need to know the disk format. If the CP/M system can read its own disks, the files can be transferred to the IBM PC. This works well when transferring Apple II CP/M and North Star Horizon CP/M files.

CP/M and PC-DOS files are similar enough that we have never had to alter a file that was transferred using the second approach (XMODEM), but Convert and Xenocopy don't always create a PC-DOS file of the same size as the CP/M original.

The biggest problem is remembering which files are PC-DOS files and which are CP/M files. If you transfer a CP/M file called DUMP.COM, for example, from a CP/M system to the IBM PC's disk and accidentally invoke DUMP.COM from PC-DOS, the IBM PC's 8088 will attempt to execute the Z80 op codes and it will be time to reach for that Big Red Switch on the side of your PC. You must run such CP/M command (.COM) files under the Emulator.

One way to keep things straight is to store CP/M files under separate PC-DOS directories. The Z80PATH environment string makes this particularly convenient.

Table 1: *Some CP/M applications that have run successfully under the Emulator.*

Standard Digital Research Programs:
ASM
LOAD
ED
DDT
DUMP
PIP

Compilers, Assemblers:
M80
L80
LIB
MBASIC
LASM
MAC
Telecon C
Software Toolworks C

Others:
WordStar 3.0 and 3.3 and MailMerge (but not SpellStar!)
dBASE II
PMATE-80 rev. 3.02
Chang Labs MemoPlan
LU version 3.00

THE EMULATOR ENVIRONMENT

The Z80PATH environment string is equivalent to the PC-DOS PATH com-

(continued)

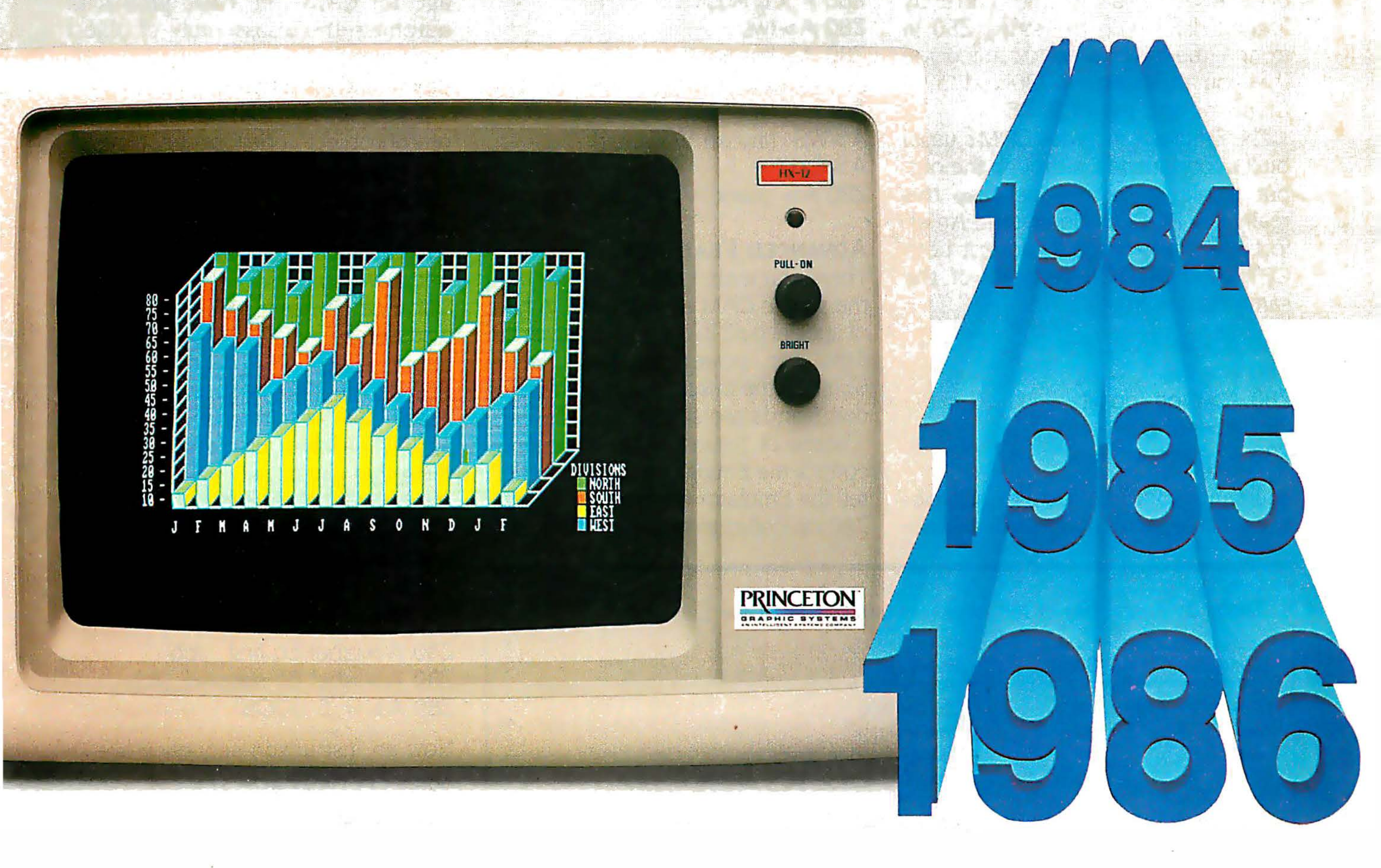
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mand. It allows you to tell the Emulator where to look for Z80 .COM files. You give it a string that is a list of fully qualified names of directories that are to be searched when the Emulator is looking for a .COM file to load and run. If there is no Z80PATH string defined in the PC-DOS environment, the search stops with the current disk drive's current PC-DOS directory. If no matching filename is found, the Emulator indicates that it doesn't know what you mean with the same terse error indication that CP/M would.

How Do I Use It?

For the most part, all you do while using the Emulator as a standard CP/M system is invoke various CP/M programs. The Emulator prompts you for input the same way that CP/M does—by displaying the currently logged drive with the string Z80 in front of the drive name, to remind you that you are using the Z80 and CP/M Emulator and not PC-DOS.

The Emulator includes CP/M's usual built-in commands, although the output display may vary because this really is a PC-DOS file system. An effort has been made to accept both CP/M and PC-DOS versions of the same command:

```
Z80 A>dir
Z80 A>stat *.*
Z80 A>type foo.txt
Z80 A>era b:*.*
Z80 A>delete *.foo
```

You can also add a few PC-DOS options, since these commands are actually passed to PC-DOS for handling:

```
Z80 A>dir /w
Z80 A>dir >foo
Z80 A>dir b:\cpm\*.*
Z80 A>rename *.c *.bak
Z80 A>copy foo.doc lpt1:
```

If a command starts with an exclamation point, the rest of the command line is passed to PC-DOS for handling. This is for PC-DOS commands that have no CP/M equivalent. You can use it to change working directories, invoke your favorite PC editor, or even "drop into" PC-DOS for a while. You do this by invoking COMMAND.COM and returning to the Emulator via the EXIT PC-DOS command.

```
Z80 A>!mkdir foo
Z80 A>!cd foo
Z80 A>!cd \cpm\test
Z80 A>!chkdsk
Z80 A>!ws
Z80 A>!format b:/s
Z80 A>!command
A>      (you're in DOS now)
A>WS  (invoke WordStar)
A>EXIT
Z80 A> (back in the Emulator now)
```

Advanced Features

There's far more to the Emulator than the simple CP/M environment. A host of special built-in commands gives the Emulator power beyond CP/M's. Some of the miscellaneous Emulator commands are shown in table 2.

Some of these built-in commands control the Emulator environment. To tell the Emulator that you want illegal Z80 op codes to cause a visible fault with a proper error message, for example, you use the illop built-in command:

```
Z80 A>illop fault
```

To tell the Emulator to not fault on illegal Z80 op codes but to treat them as NOPs, you say:

```
Z80 A>illop nop
```

The Emulator's debug facility is built into the Emulator, which means that debug commands are always available when using the Emulator. Table 3 shows some of the debug commands.

Table 2: A *sampling of the commands available under the* Emulator.

Long	Short	Meaning
delete	del	Delete file(s)
erase	era	Delete file(s)
stat	dir	Display file(s) in directory
type	ty	Type contents of file to screen
copy	co	Copy file(s)
rename	ren	Rename file(s)
help	?	Get on-line help
illop	i	Control Z80 illegal op codes
exit	e	Exit the Emulator to PC-DOS
howfast?	speed?	Calculate effective Z80 speed
coldboot!	cold!	Cold-boot the 64K-byte CP/M segment
submit	sub	Switch input to file

Disassembly and RESOURCE Commands

RESOURCE is short for "regenerating source code." Ward Christensen wrote the original RESOURCE many years ago for CP/M. The basic idea is to automate the disassembly of object code into source code, complete with labels and comments.

If you simply disassemble a piece of Z80 object code, you get a primitive type of source code. There are instruction mnemonics, so you can at least tell what instructions are involved. But addresses are just hexadecimal numbers.

You can explain to the Emulator's disassembler as much as you know about some object code. It will use this information in subsequent disassemblies, resulting in much more understandable displays. The first thing that you usually want to see are symbolic labels instead of hexadecimal addresses. The label directive (abbreviated as =) enables you to assign symbolic names to Z80 addresses:

```
Z80 A>label 5c first_fcb
Z80 A>label 6c second_fcb
Z80 A>= 5 BDOS
```

Now an instruction sequence like

```
0253 LD DE,005Ch
0256 CALL 0005H
```

will disassemble as

```
0253 LD DE,first_fcb
0256 CALL BDOS
```

The next most useful thing to do is

(continued)

assign comments to certain addresses. This is done with the built-in command comment (abbreviated ";"):

Z80 A>comment 253 "Point to FCB"
Z80 A>; 256 "open the file"

Our example sequence (when disassembled) then looks like:

0253 LD DE,first__fcb ;Point to FCB
0256 CALL BDOS ;open the file

One common problem in obtaining a sensible disassembly of object code is that of embedded data being misinterpreted as instructions. You can use the control command (abbreviated c) to control whether the disassembler interprets object code as data or instructions. Several types of these "control breaks" can be associated with an address:

Instructions—Z80 instruction mnemonics are used.
Bytes—DBs are used.
Words—DWs are used (multiple DWs per line).
Table—DWs are used (one per line).
Storage—DS is used.

For example:

Z80 A>control 253 instructions
Z80 A>c first__fcb bytes
Z80 A>c bios__table table
Z80 A>c 80 storage

Finally, there is the disassembly command itself—list (abbreviated l). You use this to list whatever object addresses you like. As the code is listed, it is disassembled according to whatever you've explained about the code.

EXPRESSIONS

Many of the built-in commands accept arguments. In general, these arguments can be numbers (in hexadecimal, decimal, or binary), ASCII characters, or symbolic labels that have been assigned via the label command. Additionally, they can be expressions made up of two or more such values joined by "+" or "−" operators. This can make things considerably easier for the poor befuddled user when it's three a.m. and he's hot on the trail of a bug. Instead of having to disassemble a piece of code with something cryptic like

Z80 A>dump 5c 6b
Z80 A>list 700 740

he can type

Z80 A>dump first__fcb first__fcb+fcb__size
Z80 A>list table__start+'A table__offset+'A

EMULATOR INTERNALS

When you type in the name of a CP/M program, the Emulator searches for the corresponding .COM file according to the Z80PATH PC-DOS environment string. When the program is located, it is read into the 64K-byte CP/M memory segment starting at address 0100. The default FCBs at 005C and 006C are formatted from the command arguments, as is the command tail at 0080. The Z80 stack is set just below our BDOS hook at address FEFE, and a word of zeros is pushed onto the stack so that if the CP/M program exits by a return, it will go to address 0000, which is a jump to the Warm Start entry in the BIOS table.

Once Z80 code is loaded into the 64K-byte CP/M memory, the guts of the Emulator—the Z80 engine—takes over. It fetches op codes from the CP/M memory and "executes" them by emulating what the Z80 would do with them.

Table 3: *Debug commands built into the Emulator.*

Long	Short	Meaning
save	sa	Save memory (starting at 0100 hexadecimal) to disk
btrace	bt	BDOS trace control or display
break	b	Set, clear, or display breakpoints
dump	d	Dump memory in hexadecimal and ASCII
find	f	Locate pattern in memory
go	g	Continue execution of Z80
patch	p	Patch memory
xreg	x	Display/modify Z80 registers
trace	t	Trace Z80 instructions
notrace	n	Invisibly trace Z80 instructions
pctrace?	pc?	Display traceback of Z80 PC values
move	m	Move memory
math	ma	Evaluate expression
args	ar	Set default FCBs at 005C and 006C hexadecimal
read	r	Read file into memory
write	w	Write memory to file

Z80 AND 8088 REGISTER EQUIVALENTS

For speed, the Z80 engine keeps in 8088 registers emulated copies of the most-used Z80 registers, as follows:

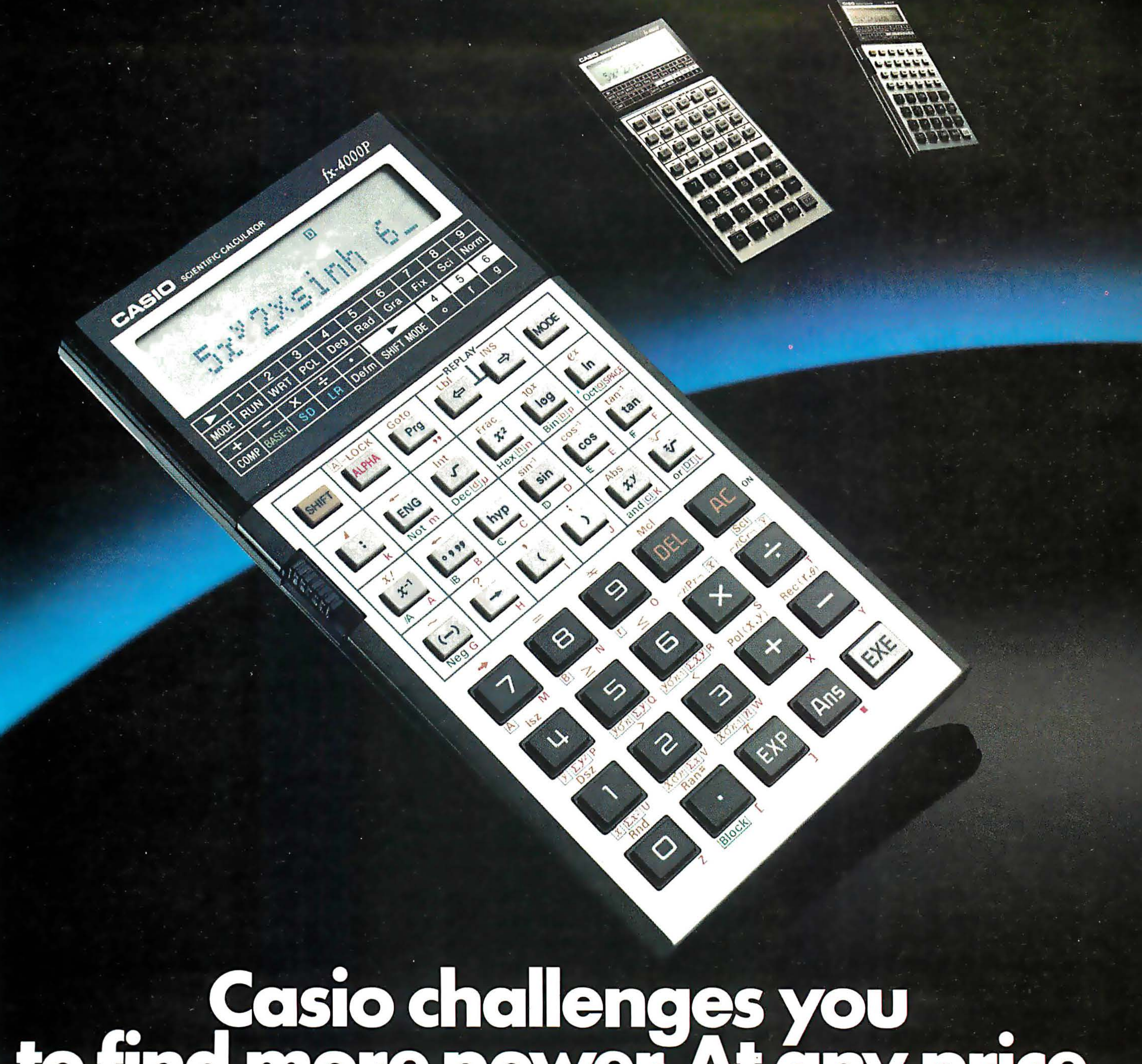
Z80 Registers	8088 Registers
A register	AL
Flags	AH
B register	CH
C register	CL
D register	DH
E register	DL
H register	BH
L register	BL
Stack pointer	BP
PC	SI

The DI and ES registers are available for temporary use by the Z80 engine. All emulation of Z80 op codes is performed either by manipulating emulated Z80 registers that reside in 8088 registers or by using DI and ES to access and manipulate RAM. Seldom-used Z80 registers are kept in RAM within the Z80 engine. Because these are in RAM and not in 8088 registers, it takes longer to access them. Fortunately, these particular Z80 registers are not used very often. They are

- the alternate registers AF', BC', DE', and HL'
- index registers IX and IY
- the interrupt flip-flops IFF1 and IFF2
- the interrupt mode flip-flop IMF
- the interrupt register
- the refresh register

While the Z80 engine is in control, the 8088 DS register points to the 64K-byte CP/M memory segment. The 8088 stack registers SS and SP are not

(continued)



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It is not enough to use the 8088's LAHF and SAHF instructions to emulate the Z80 flags.

altered and are used to maintain linkage with the calling C program.

Z80 Op Code Fetch and Emulation

The Z80 engine works as follows:

1. Fetches a Z80 op code from the 64K-byte CP/M memory segment.
2. Jumps to the code to emulate this op code.
3. Updates the emulated Z80 flags per this op code.
4. Goes back to step 1.

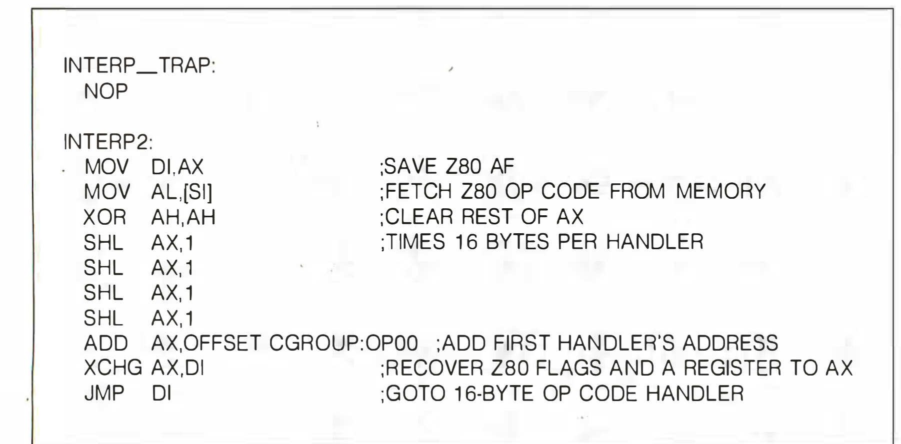
The 8088 SI register emulates the Z80 program counter. To execute the next Z80 instruction, the byte that the SI register points to is read from memory. It is then used to index into a table of 256 possible op codes, and the routine to handle this particular op code is jumped to (not called, as that is just too slow).

Each of the 256 primary Z80 op codes has a 16-byte 8088 routine that emulates it. Fixing the size of each handler at 16 bytes eliminates the need to use a real table to look up the address of the op code's emulation routine and speeds things up considerably. Some op codes just can't be fully emulated in 16 bytes. The 16-byte handlers for these few exceptions are simply jumps to larger routines elsewhere within the Z80 engine. Most Z80 op codes, however, can be handled in 16 bytes— assuming some very careful coding of the routines.

The main dispatch code is shown in figure 1. Notice that the label INTERP__TRAP is normally a NOP. If you press Break on the IBM keyboard, the Break interrupt handler (part of the Z80 engine) changes the NOP to a single-byte 8088 breakpoint interrupt (INT 3). When execution gets back to INTERP__TRAP, the breakpoint interrupt in turn causes Z80 emulation to halt, with a return from the Z80 engine to the main C part of the Emulator. This is how to interrupt the Z80 between Z80 instructions.

The 16-byte handler that is jumped to via the above dispatch code does whatever is necessary to emulate its Z80 op code. This includes adjusting the Z80 program counter (held in the 8088 SI register). The Z80 NOP op code handler, for example, increments the Z80 PC by 1. A Z80 CALL op code causes the Z80 PC to be set to the value of the called address.

When emulating an op code, the Z80 flags must be emulated identically to the way a real, hardware Z80 would. It is not enough to use the 8088 LAHF and SAHF instructions. Once the 16-byte interrupt handler has finished executing its assigned op code, it jumps back to one of eight different flag-updating routines, each of which updates the Z80 flags in whatever manner the true Z80 op code would have done. Each of the eight flag-updating routines ends with a jump back to INTERP__TRAP, thus completing the Z80 emulation loop.



```
INTERP__TRAP:
  NOP

INTERP2:
  MOV   DI,AX                  ;SAVE Z80 AF
  MOV   AL,[SI]                ;FETCH Z80 OP CODE FROM MEMORY
  XOR   AH,AH                  ;CLEAR REST OF AX
  SHL   AX,1                   ;TIMES 16 BYTES PER HANDLER
  SHL   AX,1
  SHL   AX,1
  SHL   AX,1
  ADD   AX,OFFSET CGROUP:OP00  ;ADD FIRST HANDLER'S ADDRESS
  XCHG  AX,DI                  ;RECOVER Z80 FLAGS AND A REGISTER TO AX
  JMP   DI                     ;GOTO 16-BYTE OP CODE HANDLER
```

Figure 1: *The main dispatch code for the Emulator's Z80 engine.*

CP/M BIOS and BDOS Hooks

If a Z80 HALT op code occurs in the CP/M memory segment below address FEFE, the Z80 engine saves all emulated Z80 register values and returns to the main C program. Such a HALT can be used as a debug breakpoint, or it may be a bug in the program. If the HALT occurs at an address above FEFD, some CP/M function is being requested by the executing Z80 program. To understand why and how, it is necessary to backtrack a moment.

When the Z80 engine first formats the 64K-byte CP/M segment, it zeros most of that memory. The first page, however, is formatted the same way that CP/M would format it. At location 0000 there is a jump to the CP/M BIOS Warm Start entry, which is itself just a jump within the BIOS vector table. This is the same BIOS organization that CP/M uses. Unlike CP/M, however, each BIOS vector table entry in Z80MU's CP/M memory does nothing but jump to a specific HALT higher up in memory. The address of the HALT tells the Z80 engine that the BIOS vector table entry was called.

At location 0005 is placed a jump to the BDOS function handler, which is just a HALT at address FEFE. So a HALT at this address means that the Z80 program is requesting a CP/M BDOS function. The Z80 engine looks at the address of the HALT, determines which CP/M function is being called, and emulates that function.

Emulating CP/M BIOS and BDOS Functions

A common misconception is that since PC-DOS was derived from CP/M, all you have to do to convert CP/M functions to PC-DOS functions is move the Z80 C register to the 8088 AH register, move a few other registers around, and call PC-DOS via INT 21H. In reality it's not that simple. First, let's review the various CP/M functions a Z80 program can call.

(continued)

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The basic BIOS calls generally do low-level I/O to various devices. The Z80 calling sequences here have no direct PC-DOS equivalents. What's worse, many of them deal with the disk drive in a way that is incompatible with PC-DOS disks. In Z80MU's Z80 engine, the disk BIOS calls are unsupported and cause an abort of the Z80 program that invokes them. Any CP/M program that uses the disk BIOS calls just won't make sense on the PC. Rather than be sneaky about this, the Emulator displays an obvious error message explaining that the Z80 program invoked an unsupported BIOS call and has been aborted.

The low-level nondisk BIOS calls, on the other hand, are turned into IBM PC ROM BIOS calls that correspond in meaning. The CP/M "return LIST status" BIOS call, for example, gets translated into an IBM PC ROM BIOS INT 17H to check the status of *LPT1:*. The status returned by the INT 17H is translated into the format of a real CP/M BIOS routine and given to the Z80 program. The "write character to PUNCH" BIOS call is translated into an IBM PC ROM BIOS INT 14H call to output the character to COM1:. The other nondisk BIOS calls are handled similarly.

Then there are the vanilla BDOS calls. These are used when a function number is placed into the Z80 C register and then a CALL 5 executed to get CP/M to perform that function. Such BDOS functions fall into three general groups: (1) character I/O to the terminal, the printer, etc., (2) disk file I/O, and (3) overhead (get/set IOBYTE, get allocation information, etc.).

The functions of group 1 are easily converted to their PC-DOS equivalents just by exchanging a few Z80 and 8088 registers. The functions in group 3 are generally irrelevant in the PC-DOS world. The functions in group 2, however, are the guts of a real CP/M emulator. They must be done absolutely accurately. This is where we spent most of our development time, at least as far as the Z80 engine is concerned.

RESULTS RETURNED BY CP/M

The first problem faced by a CP/M emulator is one of conventions. How is information provided to CP/M and returned by it to the Z80 program?

The first part, fortunately, has been clearly defined by years of software development for CP/M. A function number goes into the Z80 C register, an FCB (if used) is pointed to by the Z80 DE register, and so on. But results coming back from CP/M (like "Hey, I opened your file, OK?") come back in at least two places: in the Z80 A register and in the Z80 HL register.

When we tried to run LU version 3.00 (a popular CP/M utility) under early versions of the Emulator, we got garbage. A quick debug session determined that when LU checked the results of a BDOS function it ignored the A register, looking instead at the Z80 HL register. A check of every CP/M system we could get our hands

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The way PC-DOS *uses and updates an* FCB *varies from the way* CP/M *does it.*

on revealed that they all did the same thing. They returned results in two places (the Z80 A register and the HL pair), and the Z80 program could check whichever it pleased. So we changed Z80MU's Z80 engine to return results in both places, and now LU works just fine under the Emulator.

Differing Use of the FCB

The biggest trap lies in emulating CP/M's use of the FCB. The way PC-DOS uses and updates an FCB varies considerably from the way that CP/M does it. This is further confused by the fact that various versions of PC-DOS handle the FCB differently.

Never minding that CP/M keeps allocation groups in "reserved" fields of the FCB and that there's no reason in the world to emulate that behavior, there are still important differences in the use of those FCB fields that the Z80 program is "allowed" to access.

When CP/M opens a file, for example, it uses byte 12 of the FCB—the extent field. In the early releases of CP/M (before random I/O was officially added to it), programs like WordStar's install program used this byte to do random I/O, by opening various extents within a given file. PC-DOS ignores byte 12 (and in some versions zeroes it) when opening the file but uses it thereafter. So the Z80 engine's emulated CP/M "open file" function saves byte 12 across the PC-DOS call to open a file and restores it after PC-DOS is done modifying the various fields that it modifies when a file is opened.

FCB byte 13 is a reserved field in CP/M, but it is the low-order byte of the current block number in PC-DOS. The Z80 engine zeroes this field before giving the FCB to PC-DOS.

FCB byte 14 is also a reserved field, and while byte 15 (the "record count within this extent" field) is not clearly marked reserved, it ought not to be looked at by well-behaved CP/M programs. But both of these bytes are looked at (against all CP/M rules of proper software development) by some CP/M code written by Microsoft. We received calls from users of the Emulator who were having trouble running some CP/M software that had been written in a certain Microsoft compiled language. We debugged the code and found that the Microsoft subroutine library was looking at FCB bytes 14 and 15 instead of checking the CP/M return value in the Z80 A register. Rather than patch Microsoft's code to work properly, we changed the Z80 engine to keep FCB bytes 14 and 15 current according to the way CP/M would update them. This can be tricky, as PC-DOS uses FCB bytes 14 and 15 as the logical record size.

PC-DOS version 2.0 introduced extended FCBs. If the byte at FCB-7 is 00FF hexadecimal, PC-DOS assumes that this is an extended FCB and uses FCB-1 as an attribute byte. CP/M FCBs, of course, don't use this questionable convention. So when a Z80 program calls CP/M to do some operation on a file, the Z80 engine makes sure that the CP/M FCB doesn't sit 7 bytes after a byte that just happens to be 00FF hexadecimal.

CP/M FCBs are 36 bytes long; PC-DOS's basic FCB is 37 bytes long. Unless something is done by the Z80 engine to address this situation, PC-DOS will blindly use whatever byte happens to follow the 36-byte CP/M FCB as part of the random record number.

For these and other reasons, the Z80 engine copies each CP/M FCB up to a safe spot in high memory and touches it up before calling PC-DOS to do something with it. When PC-DOS is done, the modified FCB is edited to look once again like a CP/M FCB and is copied back where it originally came from so the Z80 program can examine it as if it were a plain old CP/M FCB.

Different File I/O Error Return Values

Some CP/M programs don't really examine status returns from CP/M file operations except to check for zero or nonzero. Others actually do check for specific CP/M error returns as follows:

01 = reading unwritten data
03 = cannot close current extent
04 = seek to unwritten extent
05 = cannot create new extent
06 = seek past physical end of disk

PC-DOS file operations return completely different error values. So the Z80 engine translates an error returned by PC-DOS into the corresponding CP/M error value before passing it back to the Z80 program.

Handling EOF

Many CP/M programs check for Control-Z (end of file) on sequential input files. PC-DOS, of course, doesn't need a Control-Z at the end of a sequential file. It knows the exact size of the file, regardless of file contents.

So if a CP/M program (which expects Control-Z for end of file) reads a PC-DOS sequential file that doesn't have a Control-Z, the results can be rather odd. Some CP/M programs will report an I/O error. Others blindly assume that end of file was reached when any read error occurs.

For this reason, the Z80 engine keeps a sharp eye out for the PC-DOS "end of file" or "partial record" error returns. If either is found, the Z80 engine returns to the Z80 program a buffer that is filled out with Control-Z characters. So things work out just fine, regardless of the presence or absence of Control-Z characters in the input file.

CP/M BDOS Functions That Differ in PC-DOS

The CP/M "search for next" BDOS function does not require an input argument. The search continues per data saved from the last search that was done (usually a "search for first" that provided an FCB). The PC-DOS "search for next" function, however, does require an FCB as input. So when the Z80 engine emulates a CP/M "search for next" BDOS function, it passes to PC-DOS the updated FCB that was used for the previous search. The FCB is kept in a special area reserved just for this purpose.

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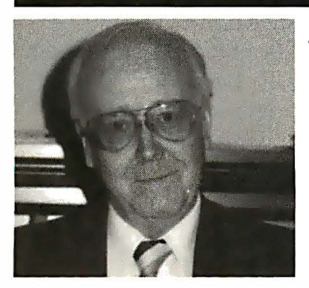
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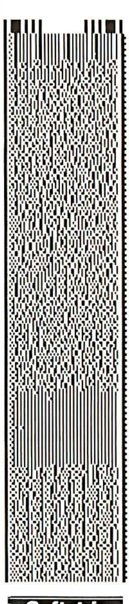
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The CP/M "buffered keyboard input" BDOS function returns when the buffer is full. The corresponding PC-DOS function does not: It waits for Return to be pressed. So the Z80 engine simply can't call PC-DOS function 10. It must itself emulate the entire operation of this function, using low-level console I/O routines.

SUMMARY

In this overview of Z80MU, the Z80 and CP/M 2.2 Emulator, my intent has been to give a feel for the capabilities of the program. More details, including explanations of all built-in commands, reside in the user's guide that is distributed with the Emulator.

Response to the Emulator has been favorable. This reinforces our conviction that releasing the package to the public domain was the right thing to do. A few clear-cut bugs have been found by users in the field. These have been fixed. In addition, some excellent suggestions have been made as to features to be added.

Many other details need to be addressed by anyone who wishes to make such an Emulator. I have merely presented some of the most significant ones. Discovering the rest, quite frankly, is half the fun.

THE FUTURE

The Emulator is still in active development. At the moment, we are implementing the following changes:

1. The C part of the Emulator is being rewritten in Microsoft C version 3.00.
2. The user interface is being redirected to fast screen I/O routines, bypassing PC-DOS entirely.
3. The NEC V20 chip is being supported. This provides faster performance than with software-only emulation but is limited to 8080 op codes only.
4. The much-rumored NEC V25 chip (which executes Z80 op codes) will be supported if and when NEC announces it.
5. From all of the Z80 add-on boards for the PC, we will select one to be supported by the Emulator. This hardware/software combination will be the most powerful Z80 environment available. ■

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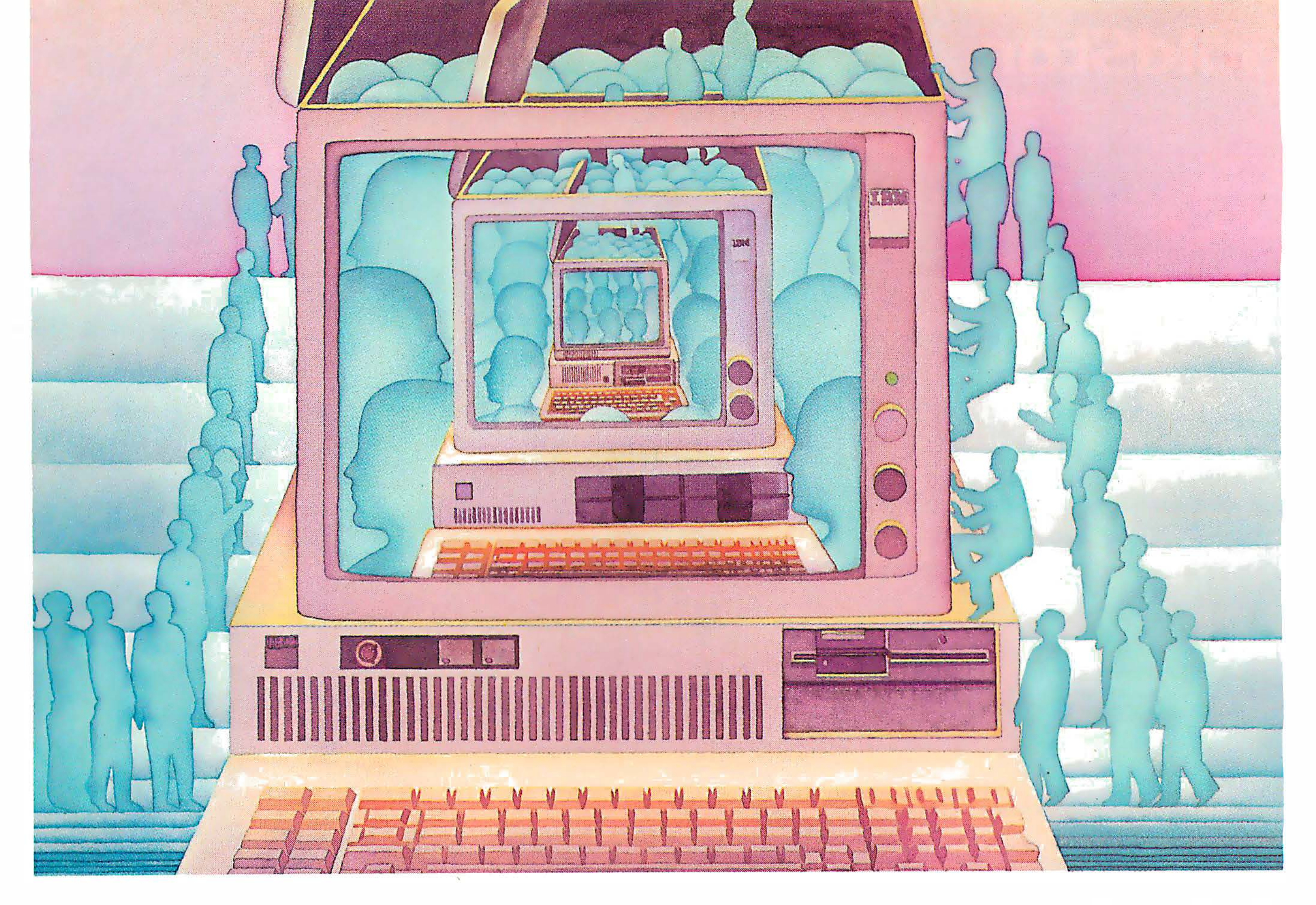
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CP/M HALL OF FAME

BY BROCK N. MEEKS

A roundup of some of the best public domain CP/M software

THERE IS A CORE of time-tested, quality CP/M public domain programs, programs that are candidates, if you will, for the CP/M Hall of Fame. (If sled dogs can have a Hall of Fame, why not PD software?) The programs outlined below are some of the best in the field and appear on practically any CP/M user's "must have" list.

ZCPR3.COM

ZCPR3 is a powerful program for turbocharging CP/M's console command processor (CCP). Created by Richard Conn, ZCPR3 (Z80 Command Processor Replacement) is an entire operating system. Besides being a replacement for your CCP, ZCPR3 also offers a set of software tools, utility programs that use ZCPR3's special features.

ZCPR3 enhances some of the built-in commands of your present CCP. For example, under ZCPR3 TYPE will pause at every screen full of text (22 lines). Additional built-in commands such as LIST come with ZCPR3. LIST enables you to dump a file to the printer. Here are some of the more important functions of ZCPR3:

Named directories—A0: and B13: don't tell you anything about what programs are in those user areas. With this system you can give A0: the name dBASE: or B13: the name TEXT:.

Search paths—If you specify a path, ZCPR3 will search for a particular program along that path until it finds it. For example, if you enter dBASE at the B> prompt, ZCPR3 will automatically search for it on drive A if it is not found on drive B. The pathways you specify can be quite complicated, a feature any hard disk owner will quickly appreciate.

System security—This utility allows you to effectively lock out certain drives or user areas. You can also eliminate the ability to run dangerous commands such as ERA *.*. This feature is known and loved by many bulletin board sysops.

ZCPR3's utility programs total 76, too many to list here. These are mainly for manipulating and maintaining how you use ZCPR3. For instance, PATH alters any previously defined search path, DIFF compares any two files, and FINDF ferrets out a file from all possible directories.

SDD.COM

This file directory program is often renamed D.COM and takes up 80K to 100K bytes of source code. It is loaded with bells and whistles. Figure 1 shows a list of available parameters called with the command SDD $?.

To get a listing of all files, in all user areas, dumped to your printer, you would issue the command D $AP. If you wanted to have all files archived in libraries printed out as well, the command would be D $APL.

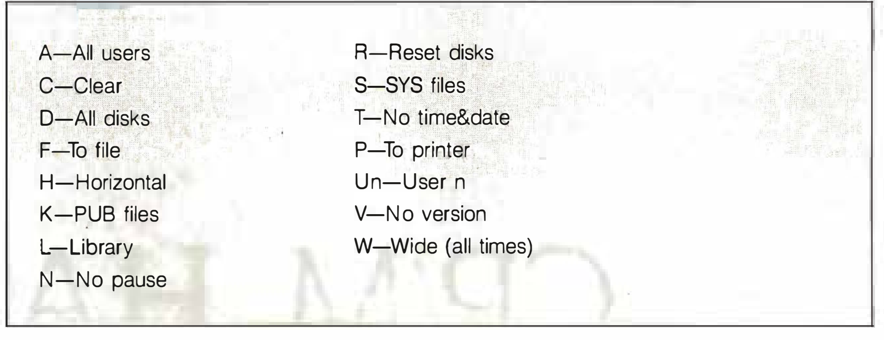
NSWP207.COM

New Sweep, as this file-maintenance program is called, is for people who can never remember the syntax for the PIP command. It was written by Dave Rand and does so much that its menu (see figure 2) speaks for itself.

The Tag option lets you mark multiple files for any particular operation. You simply tag each file by pressing "T" after each filename. (When the program is executed, all files on disk are listed vertically.) When you've tagged all the files you want to work with, you can erase them, mass-copy

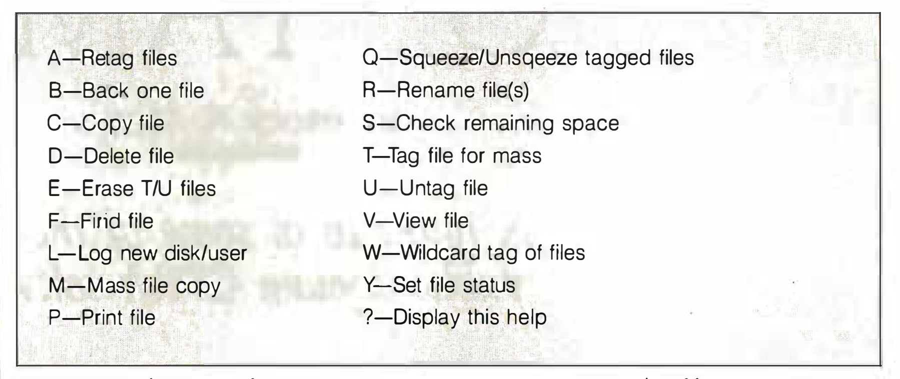
(continued)

Brock N. Meeks (8383 Center Dr., Suite C, La Mesa, CA 92041) is a contributing editor for Profiles *and* Microtimes *magazines. He is the winner of a Computer Press Association award for outstanding writing.*



A—All users	R—Reset disks
C—Clear	S—SYS files
D—All disks	T—No time&date
F—To file	P—To printer
H—Horizontal	Un—User n
K—PUB files	V—No version
L—Library	W—Wide (all times)
N—No pause	

Figure 1: *The list of parameters available for running* SDD.COM, *a directory program.*



A—Retag files	Q—Squeeze/Unsqeeze tagged files
B—Back one file	R—Rename file(s)
C—Copy file	S—Check remaining space
D—Delete file	T—Tag file for mass
E—Erase T/U files	U—Untag file
F—Find file	V—View file
L—Log new disk/user	W—Wildcard tag of files
M—Mass file copy	Y—Set file status
P—Print file	?—Display this help

Figure 2: *The menu of* NSWP207.COM (*New Sweep*), *a* CP/M *file-maintenance program.*

them to a specified drive and user area, or squeeze/unsqueeze them. (Squeezing a file compresses it, saving disk space or allowing shorter transfer times via modem. Unsqueezing restores it to its original form.)

The Print option dumps a file to the printer. View lets you read a file on screen (even if the file is squeezed, which normally renders a file unreadable unless unsqueezed). The "Y" option allows you to assign any file a particular status (1–4,R,O).

NULU151.COM

This library utility helps you get around CP/M's limit of 64 filenames per floppy disk by allowing you to group a set of related files under a single filename. All your old tax spreadsheet files can be grouped in a library called 1985TAX.LBR. Since a library, regardless of how many files are tucked inside, takes only one slot of the allotted 64 filenames, you can store many more programs on a disk. Also, when using a hard disk, a library file can save you space. Although a 1K-byte file might be allotted the minimum 4K bytes on a hard disk, four 1K-byte files in a .LBR file would take up only 4K bytes, a saving of 12K bytes if stored individually.

NULU, written by Martin Murray, is an enhancement of the original LU (Library Utility) program by Gary P. Novosielski. This program lets you set up individual libraries on disk. The accompanying documentation file is 36K bytes long and explains in detail how the program functions.

NULU is a handyman for file manipulation. You can unsqueeze, rename, delete, add, and view file entries. It is also indispensable for transferring several related files via modem. You can pack your library file with squeezed files and send the single .LBR file to a remote computer in much less time than it would take to transfer each individual file.

MEX114.COM

MEX (Modem Executive), a communications program, is a direct descen-

(continued)

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dant of the MODEM7 communications package and has a widespread user base. A commercial counterpart of MEX is sold through Night Owl Software, but the public domain version doesn't lack many features of the commercial product.

MEX supports all the latest file-transfer protocols and even includes the ability to create script files (a series of commands that let the program automatically log on and interact with the remote computer once the carrier is detected). MEX calls these READ files. Overlays exist for virtually every CP/M system and modem.

A command called CLONE allows you to configure MEX for many different systems. The program can also store custom phone lists. If you type in a stored name, the modem will dial the corresponding set of numbers (including any alternate carrier access codes, like for MCI or Sprint).

OTHER CANDIDATES

In voting members into any Hall of Fame, there is always debate, controversy, and gnashing of teeth. My nominations will no doubt draw fire from those who think that other programs should be included. Here are some that could make it on the next ballot.

VDE—a superb 7K-byte screen editor, though word processor comes to mind immediately. This little program is great for editing downloaded text files, and it can do several of the same functions as WordStar, including word wrap. It is also great for writing programs.

SODU (Screen Oriented Disk Utility)—has saved its share of crashed disks. A disk editor like this lets you examine or change the information on disk byte by byte. With it you can recover damaged files that other programs (like your word processor) refuse to boot up.

MCAT—can manage that zoo you call a floppy disk file. The program automatically catalogs and records each filename on each disk. The associated file XCAT allows you to print out the listing.

EX—a small wonder that is the utility that CP/M's built-in SUBMIT program should have been. EX is quicker and more versatile than SUBMIT.

RESQ—recovers a text file from memory after you enter a word or phrase to search for. The file is restored from the first occurrence of the word or phrase to the end of the file.

UNERA—the ultimate recovery tool that will undelete files you just deleted from disk. It restores a file in full if you haven't written to the disk since erasing the file.

I could mention many more programs, but you will find those listed above to be reliable and upgraded regularly.

Editor's note: Owing to the size of these programs, the executable code for all the CP/M programs is available only on BYTEnet ((617) 861-9764) and on BIX. Readers may also want to contact the CP/M Users Group, 345 East 86th St., New York, NY 10028. ■

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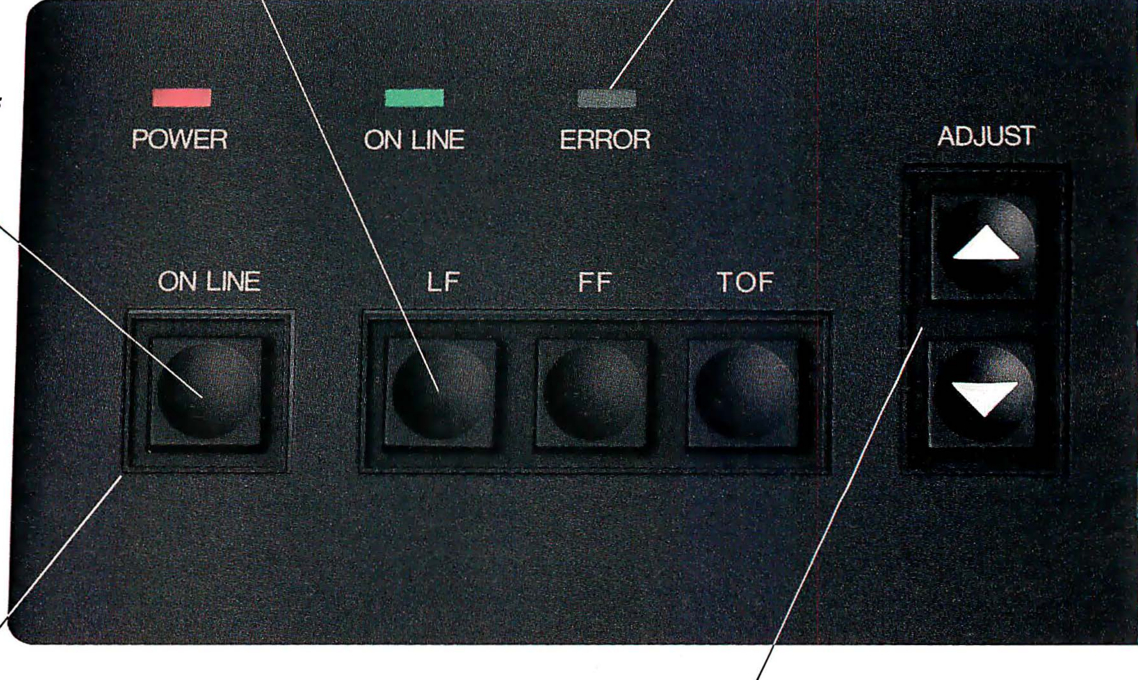
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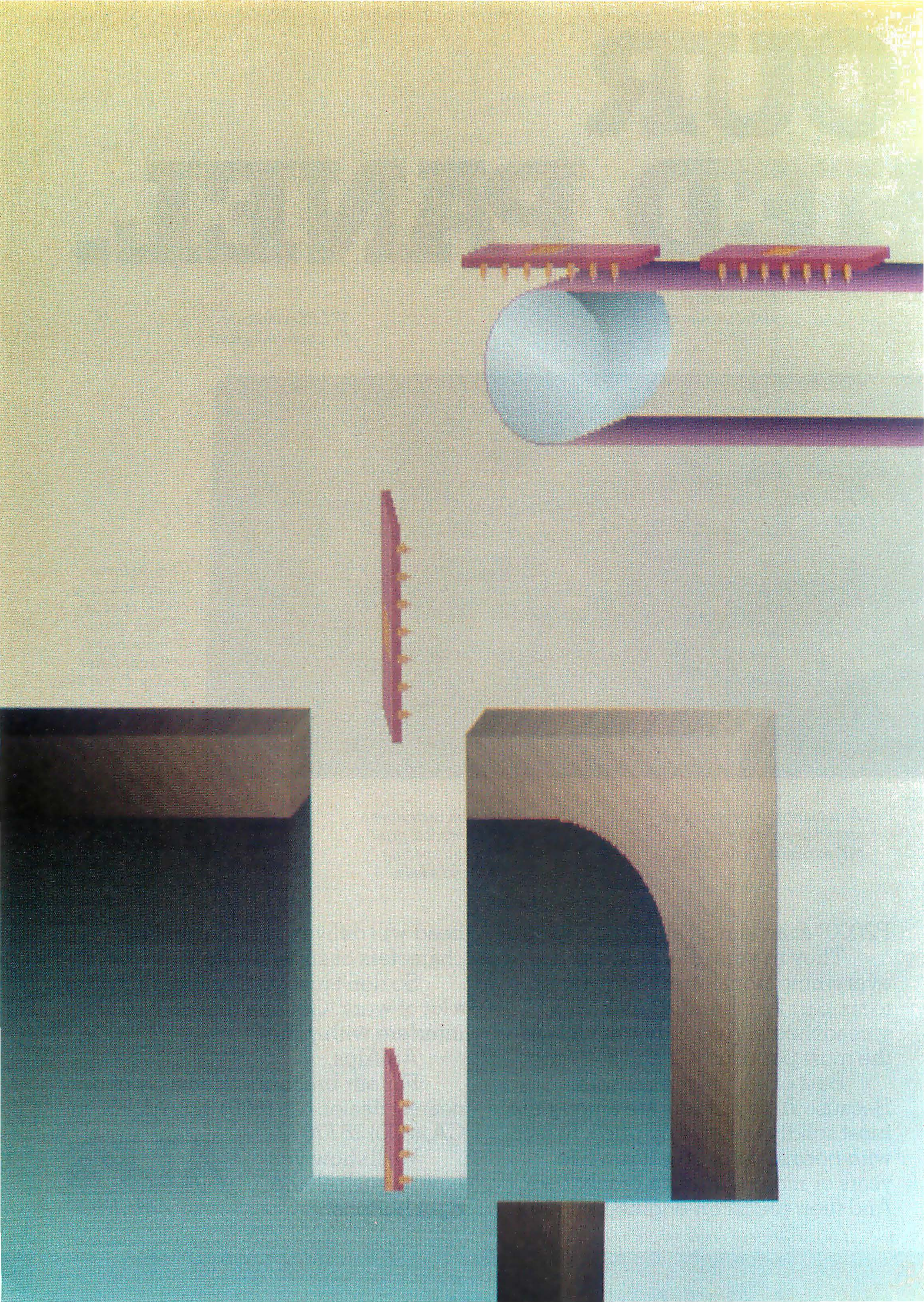
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Reviews

THE COMMODORE AMIGA is a special machine. Tom Thompson provides a detailed look at its capabilities and performance. In his view, the Amiga's spectacular graphics is the major strength of the machine, but the peripherals and software also contribute to the system's viability. Still, he reports on the quirks and problems that you will face with AmigaDOS and the multitasking operating system.

The Compaq Portable II is a compact version of the Compaq Portable 286. Stan Miastkowski examines the Model 3, which has a single floppy disk drive, a 10-megabyte hard disk drive, and 640K bytes of RAM in a 26-pound case. He has found that the machine is well built, highly compatible, and easy to expand, but highly priced.

It doesn't take long after you've purchased a hard disk to realize how vulnerable you are unless you back up your files. Malcolm Rubel reviews four tape backup units and the Alpha Microsystems' Videotrax, a VCR alternative. He concludes that the Tecmar QIC-60 is a winner as far as speed is concerned, although the other units perhaps provide a better value or an easier environment for beginners.

Robert Schalkoff looks at the muLISP-86 LISP development system, which is identical to Microsoft LISP. He has found that the major strength of the language is its suitability for use within the constraints of a microcomputer environment.

Mark Bridger examines ITC's Modula-2, and he compares it to Turbo Pascal. He recommends that you examine your needs before making the transition from Turbo Pascal.

Malcolm Rubel also reviews Microsoft Word version 3.0. The application is full-featured, but he concludes that the word processor lacks some of the comforts and the speed that he has come to expect.

Finally, Rubin Rabinovitz compares the latest version of The Norton Utilities to PC Tools and to Super Utility. He has found that The Norton Utilities offers the greatest number of features for file recovery and that PC Tools is somewhat easier to use and is more reasonably priced.

R·E·V·I·E·W·E·R'S N·O·T·E·B·O·O·K

I often wonder whether the time I spend shaping my working environment really pays off. I suppose that my work habits are now more efficient, and I certainly enjoy watching macros give me more command over the system. But my investment in time, if not in money, is considerable.

On my IBM PC, I have an AUTOEXEC.BAT file that takes 3 minutes to boot and, despite having 640K bytes of RAM, I have less than 80K bytes for my work space. The reason may be familiar to you. I have a passion for RAM-resident software.

I use SideKick, SuperKey, and Turbo Lightning from Borland International, PopDOS from Bellsoft Incorporated, Kwic Query, an excellent new RAM-resident index of BYTE's back issues from Innovative Ideas Incorporated (1226 Holloway St., Dept. BPA, Lafayette, IN 47905, (317) 743-6416), two public domain applications (a digital clock and a print spooler), and a RAM disk to hold the Turbo Lightning dictionary. But passions for RAM-resident software can get you into trouble, especially when you load in several. For example, when I tried The Norton Commander last month, DOS commands no longer entered SuperKey's command stack. The Commander captured them all. Many utilities like PRD+ and SuperKey do not work together; in this case, I assume because they use the same interrupts. Consequently, there are times when I have to change the AUTOEXEC file and reboot.

I was therefore excited to get Referee from Persoft (2740 Ski Lane, Madison, WI 53713, (608) 273-6000). This product sets up environments in which you can specify which of your RAM-resident packages are active with each of your applications. You might set up Turbo Lightning to be active when you are on-line (very useful for avoiding cumbersome line editors) but inactive at the DOS level. Alternatively, with memory to burn, you might load PRD+ for use with your main editor and SuperKey for use at the DOS level and in other applications.

I can therefore recommend Referee, but it too introduced some incompatibilities. I found that once I had loaded Referee, SuperKey macros could no longer call SideKick functions. The reason, according to Persoft, is that Referee employs two interrupts that SuperKey needs to recognize that SideKick is there. Of interest is Persoft's claim that a similar but as yet unavailable utility has the same problem.

Amiga owners are probably scoffing at this discussion, since the reason for having RAM-resident utilities in a sense is to simulate a multitasking environment. Why struggle with incompatibilities among utilities when a multitasking operating system can solve all these problems by providing access to every application you desire?

Order, for example, is a desktop organizer software package for the Amiga from the Northeast Software Group (165 Dyerville Ave., Johnston, RI 02919, (401) 273-1001). It provides a telephone directory, a 21-function calculator, a clock and message facility, a 7-function scratchpad, a calendar, and a screen dump utility. With a hard disk, you can call up these functions nearly as fast as on the IBM PC.

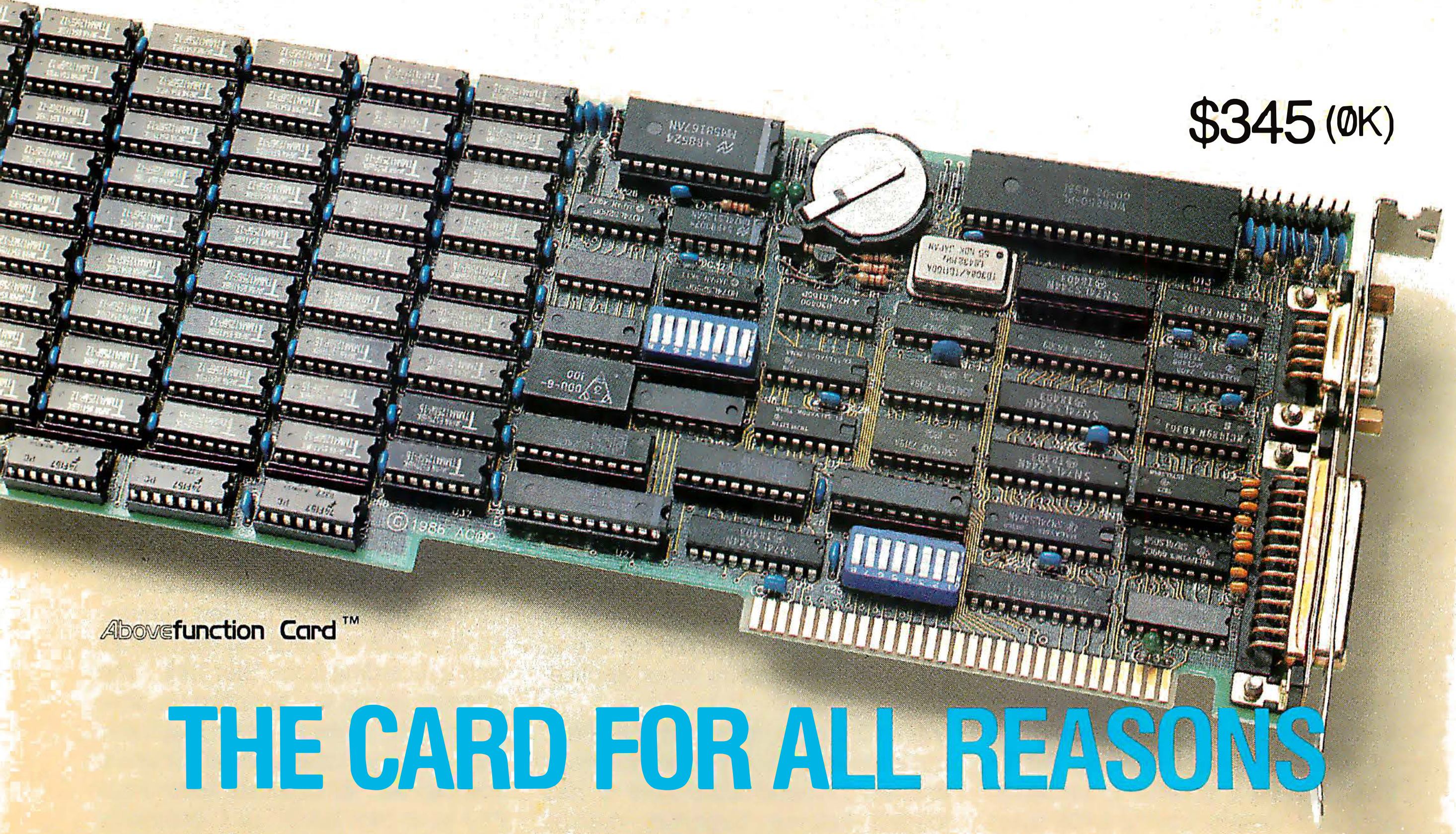
Like me, you may well be more interested in the Amiga's graphics and sound environment than its multitasking abilities. We just received FutureSound from Applied Visions Incorporated (15 Oak Ridge Rd., Medford, MA 02155, (617) 488-3602). This sound digitizer includes everything you need to digitize voices, sound effects, and music, using up to four tracks at a time and at up to 28,000 samples per second. In a few minutes we were able to splice our own voices with a recording from "Star Trek." The software allows you to speed up, slow down, or reverse the playback, change the volume, and edit sounds. You can also incorporate recordings into your own BASIC or C programs by saving the digitized sounds in IFF format.

We also have Digi-View from NewTek (701 Jackson St., Suite B3, Topeka, KS 66603, (913) 354-9332), a video digitizer that lets you capture, display, and store images in the Amiga's 4096-color hold and modify mode, in the standard 32-color IFF format, and in 640- by 400-pixel monochrome. Digi-View plugs into the parallel port and uses a coaxial cable to connect to an RS-170 monochrome slow-scan video camera with two-to-one interlace. NewTek supplies the Panasonic WV-1410 camera as an option. To capture images, you use a color filter wheel that mounts in front of the camera. The process is fairly quick (about 30 seconds for full color), and the final quality is excellent.

Lest I forget my roots, I should mention a neat item for the Atari 800. Electronical Software (P.O. Box 8035, Rochester, MI 48063, (313) 258-5455) offers YEMACYB, a color graphics printer driver that lets you make color printouts with your black-and-white dot-matrix printer. With this software and four-color printer ribbons, you can generate color printouts of any graphics-7 or 7-plus displays saved in Micropainter-file format.

Macintosh users, take heart. Next month I will report on the MacWorld Expo in Boston.

—Jon Edwards
Senior Technical Editor, Reviews



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THE COMMODORE AMIGA

BY TOM THOMPSON

The strong point of this well-designed machine is spectacular graphics



The Amiga from Commodore International is a business machine, a graphics workstation, a multitasking system, and a home computer. A bold statement, but the Amiga has a unique hardware design that gives it sufficient power, especially when combined with some pricey peripherals and improved software, to meet most of these expectations.

HARDWARE

The basic Amiga comes with 256K bytes of RAM, and you can upgrade to 512K bytes easily with a 256K-byte RAM expansion cartridge that plugs into a slot behind a front panel. A built-in 3½-inch double-sided disk drive holds 880K bytes, and the machine has a connector for an external drive. The Amiga can support three additional drives—either double-sided 3½-inch or double-sided 5¼-inch. The system has programmable serial and parallel ports. Two RCA jacks provide stereo audio output. The two joystick ports can be used to connect a two-button optomechanical mouse.

The Amiga provides analog and digital RGB output for color monitors and a composite video output that can input directly into a VCR or color monitor. The Amiga also has an RF modulator port for TV outputs, but you need an external RF adapter unit for this type of use. On the right side of the machine, a panel covers the expansion bus interface, a card edge into which you can attach additional memory or special peripherals. An important feature of the hardware is that you can synchronize the display to an external television signal, allowing the possibility of receiving, viewing, and processing VCR or video camera input.

The Amiga uses a Motorola 68000 microprocessor chip running at 7.16 megahertz. Three custom chips handle the bulk of the display control, sound generation, and DMA (direct memory access) data transfers (see "The Amiga's Custom Graphics Chips" by Phillip Robinson, November 1985 BYTE). You can manipulate eight reusable sprites on two playfields with priority control and collision detection. Area-fill and bit-plane copying are also supported, and four programmable audio channels are available. For additional information on the Amiga's hardware, see "The Amiga Personal Computer" by Gregg Williams, Jon Edwards, and Phillip Robinson, August 1985 BYTE.

I was disappointed to find out that the Amiga doesn't have a battery-operated clock. Such clock circuits are not difficult to build, and with 880K bytes of data per floppy disk drive, a time stamp on a file is a requirement. The clock should be standard, but you can buy peripherals that contain a clock.

DISPLAY

The Amiga display has two resolutions. Low resolution is 320 pixels per line and 200 lines per screen, with a choice of 32 colors from a palette of 4096. High resolution is 640 pixels per line for 200 lines, displaying 16 colors out of 4096. An interlace mode allows you to double the vertical resolution: 320 pixels for 400 lines in low resolution and 640 pixels for 400 lines in high resolution. A special mode called hold and modify (HAM) allows you to use six bit planes in a controlled manner to display the entire 4096 colors simultaneously. This last mode is perhaps the most spectacular: Digitized pictures utilizing HAM have a television-like quality to them due to the range and subtle shading of the colors displayed (see photo 1).

The Amiga can present text in a variety of sizes, colors, fonts, and styles. You can also present text in 60 or 80 characters per line. The system ROMs contain two default system fonts; other fonts are stored as .font

(continued)

Tom Thompson is a technical editor for BYTE. *He can be reached at* BYTE, *One Phoenix Mill Lane, Peterborough,* NH 03458.

files on disk. The operating system will recognize additional .font files if you copy them to the disk and then install them.

The Amiga has no problem with low-resolution displays, but an annoying jitter appears in the interlace mode and in high-resolution displays. A monitor with high-persistence phosphors could alleviate the problem but at extra expense. I also found that after using the 80-column text mode for several hours, my eyes began to burn. I found it much easier to endure the 60-column mode.

Commodore offers an optional monitor, the 1080, which has a composite video input, allowing it to serve as an output device for a VCR or another computer.

KEYBOARD

The Amiga has a detached keyboard with 89 keys. In addition to the usual alphanumeric keys you'll find Esc, Ctrl, Del, two Alt keys, two Amiga logo keys, ten function keys, and four cursor keys laid out in an intuitive cross pattern.

The keyboard can be read as processed input or as unprocessed (raw) input, depending on how the application has opened the console device. The raw mode interprets the keyboard as keycodes, allowing you to have fine control over the input. For example, you can differentiate between the left Alt key and the right Alt key if your application requires it.

DISK DRIVES

I appreciated having an external 3½-inch drive, which increased the machine's storage capacity to 1.8 megabytes. The Amiga cannot boot off the external drive, but having an external drive eliminates some of the disk swapping that occurs with some applications and compilers.

A push button ejects the disk. This physical control appeals to some users, but you can destroy a disk's contents if you eject it prematurely. This shouldn't normally be a problem, but the Amiga seems to take a long time, sometimes several seconds, to flush the last of the data to a disk. The possibility of an accident seems great enough to justify your getting a disk-salvage utility.

OPERATING SYSTEM

The operating system is composed of 192K bytes of multitasking executive saved in 256K bytes of write-controlled storage (WCS) RAM. When the Amiga was first released, the operating system software design was not complete. The workaround provides the operating system on a floppy disk called the Kickstart that loads into the WCS at boot-up. The WCS uses its own memory; it does not use the 256K bytes of RAM that comes with the basic machine. You complete the boot process by inserting a Workbench disk (Commodore's term for the Macintosh-like window/icon user interface) or the system-installed Command Line Interface (CLI) disk.

Improvements to the executive are issued through dealers at no charge. The current Workbench version is 1.1, with version 1.2 now in beta test. Each revision has introduced major improvements in the overall operation of the machine.

You have a choice of how to work with the Amiga. There is Workbench, a mouse-driven, icon-based windowing interface, or AmigaDOS, which is a sophisticated CLI. Workbench is actually "bolted" to the top of AmigaDOS: Actions performed on the Workbench call AmigaDOS functions. Either interface can start the other. From the Workbench you can double-click on a CLI icon to open a window with a simple CLI prompt, or from AmigaDOS you can issue the LOADWB command, which starts Workbench. I performed all system benchmarks under both Workbench and AmigaDOS.



Photo 1: A *demonstration of the Amiga's hold and modify mode.* (*Data file courtesy of* NewTek.)

WORKBENCH

Like the Macintosh desktop, Workbench has multiple windows, a menu bar, icons representing disks, and a Trashcan. You can move, resize, open, and close windows using the mouse. You use the left mouse button for operating on a window or its contents and the right mouse button to activate and make selections on the pull-down menus. It takes a little practice, but it is easy to get used to.

Various icons represent runnable applications. To execute them you double-click on the icon. You can also drag them to another location or to another disk, triggering a copy operation. Drawers correspond to Macintosh folders and, like the Macintosh

(continued)

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Size
17¾ by 13 by 4¼ inches
13 pounds

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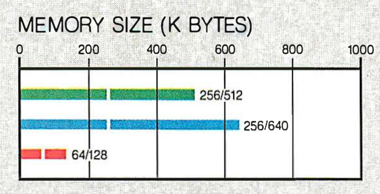
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Tutorial (Mindscape)
Kaleidoscope (Electronic Arts)

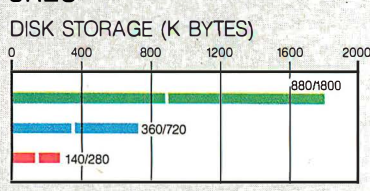
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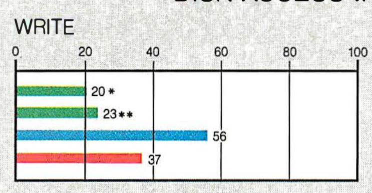
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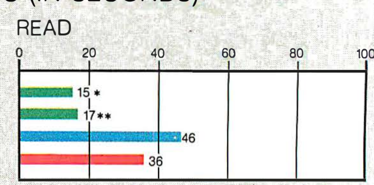
SYSTEM FEATURES



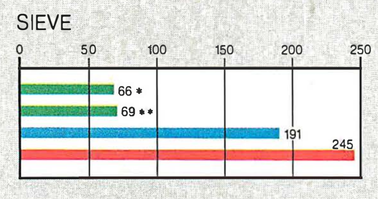


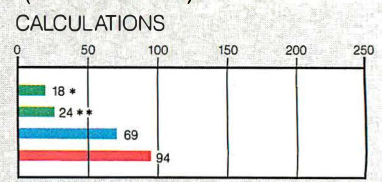
DISK ACCESS IN BASIC (IN SECONDS)



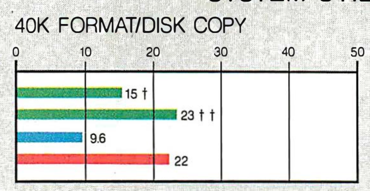


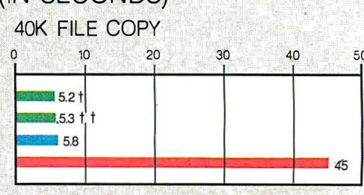
BASIC PERFORMANCE (IN SECONDS)



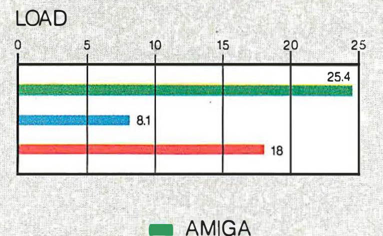


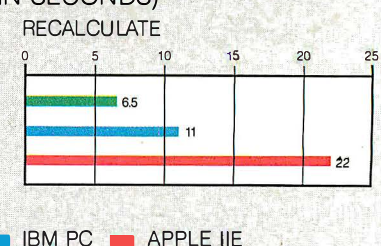
SYSTEM UTILITIES (IN SECONDS)





SPREADSHEET (IN SECONDS)





AMIGA　IBM PC　APPLE IIE
* Amiga BASIC　** ABasiC
† AmigaDOS　†† Workbench

The Memory Size graph shows the standard and optional memory available for the computers under comparison. The Disk Storage graph shows the highest capacity for a single floppy disk drive and the maximum standard capacity for each system. The graphs for Disk Access in BASIC show how long it takes to write and then read a 64K-byte sequential text file to a blank floppy disk. (For the program listings, see BYTE's *Inside the IBM PCs*, Fall 1985, page 195.) The Sieve graph shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The Calculations graph shows how long it takes to do 10,000 multiplication and 10,000 division operations using single-precision numbers. The System Utilities graphs show how long it takes to format and copy a 40K-byte file using the system utilities. The Spreadsheet graphs show how long it takes to load and recalculate a 25- by 25-cell spreadsheet in which each cell equals 1.001 times the cell to its left. BASIC benchmarks were performed for both ABasiC and Amiga BASIC with only the benchmark program running. The ABasiC programs use a different syntax to open files, and Amiga BASIC requires a CLEAR ,30000,30000 command for the Sieve program to run. All System Utilities benchmarks were run under Workbench and AmigaDOS. The spreadsheet used was Lattice's Unicalc Spreadsheet version 1.0. All tests were done on an Amiga 1000 using Workbench 1.1 and AmigaDOS 1.1. The Amiga had two 880K-byte drives and 512K bytes of memory.

Hierarchical Filing System, each drawer represents a subdirectory.

Although Workbench works well, it has a few quirks. To save a preferred arrangement of icons, you must select an icon and then choose Snapshot from the Special menu. You repeat this process until you've preserved the location of every icon, a very clumsy method. The Macintosh Finder saves the location automatically. Also, new files generated by applications don't appear in a window until you first close and then reopen the window. This isn't a serious problem, but it can be confusing.

When you have multiple processes running in separate windows, you make a window active by pointing to it and clicking with the left mouse button. However, the active window doesn't come to the front of the screen. If it is hidden by other windows, it will stay that way. In fact, in some cluttered screens it can be difficult to use the front and back window controls, called gadgets, to bring the desired window to the front. Worse, clicking on a window's front or back gadget makes that window active. Once you've positioned the desired window at the front of the screen, it may not be the active window. You might therefore enter keyboard I/O into the wrong process.

AMIGADOS

AmigaDOS is the CLI interface to the Amiga. It's based on Tripos, a multitasking system written by Metacomco in England (see "Tripos—The Roots of AmigaDOS" by Dick Pountain, February BYTE). Experienced computer users will probably rely on AmigaDOS, since all the development software, programming languages, and assemblers operate exclusively in this environment.

AmigaDOS allows you to assign logical paths, and an EXECUTE command lets you submit batch files with parameter passing. At boot-up the Amiga searches the *s* subdirectory of the boot disk for a batch file called Startup-Sequence and, if it is present, executes it. This gives you a way to make logical device assignments to certain volumes or subdirectories, set the stack size, or prompt for the current time and date each time you start. You also select the operating system you'll start under (Workbench or AmigaDOS) in this file.

Commands are programs stored in the *c* subdirectory on the boot disk. AmigaDOS scans this directory when you enter a command and loads the appropriate program into memory to complete the request. This slows operations because every command, including DIR, requires a disk access. You can rename these programs to suit your own preference.

AmigaDOS has a built-in RAM disk, RAM:, whose size is limited only by the amount of available memory. You can customize the Startup-Sequence file to load frequently used commands such as TYPE, DIR, and EXECUTE into the RAM disk and logically assign it as the command directory, eliminating the penalty of accessing the floppy disk.

You can obtain help for some commands by executing them with no arguments. FORMAT, for example, provides you with a complete set of arguments and keywords to format a disk. Not all commands provide this feature: COPY instead tersely states "Bad arguments." I'd like to see all commands that require keywords or switches to provide some sort of self-help because AmigaDOS doesn't resemble MS-DOS in some areas.

AmigaDOS has quirks, most of which are due to its dissimilarity to MS-DOS. First, AmigaDOS handles wild cards differently, mainly by not using the asterisk (*) as a wild-card delimiter. The COPY command requires an ALL switch to copy all the files on a disk or in a subdirectory. COPY does not perform concatenation: You must use a JOIN command, which doesn't offer self-help either. Second, AmigaDOS doesn't recognize the conventional Ctrl-S/Ctrl-Q data throttle. To stop output, you hit a key; to restart, you hit Return, backspace, or Ctrl-X.

I've crashed the machine under AmigaDOS by using COPY with the ALL switch to transfer files to the RAM disk. Everything proceeds smoothly until the Amiga runs out of memory, at which point you get a fatal crash. This might happen to you by accident if you put a number of source files in RAM: during the development of a program. I don't know if this is the fault of the Amiga operating system or of the COPY command. It does show that the version 1.1 system software still has some rough edges.

The Amiga handles multitasking quite well, but only if all the programs are well behaved.

MULTITASKING

The Amiga provides multitasking, allowing you to run several programs simultaneously. The programs share system resources such as memory or disk drives without conflict. However, the Amiga multitasking executive does not support virtual memory: Either you have enough memory to load your applications or you don't.

With this fact in mind, how well does the Amiga handle multitasking? The display, normally one of the most CPU- and I/O-intensive processes, is managed effectively by the custom chips. Other types of I/O like disk and serial port accesses tend to slow applications down, but primarily because of the speed of these devices rather than the overhead required. I've tried a mix of different programs in a variety of ways with no problems (see photo 2). At the same time, attempting to run a buggy C program I had written hung the entire system, taking with it all the programs that were running. The moral here is that the Amiga handles multitasking quite well, but only if all the programs are well behaved.

How much overhead do additional tasks add to the system? I experimented with running the C language version of the Sieve program with another graphics-intensive program running in the background. I chose this program to experiment with how

(continued)

much the custom hardware degraded performance when it had to cycle-steal heavily from the 68000 microprocessor. I used the bouncing ball demo, Boing!, plus the Robocity and amiga3d demos as background programs. The results are shown in table 1. The Sieve runs in roughly twice the time that it had previously, but with two programs, one with an extremely complex graphics display, running simultaneously. Impressively, the Amiga is also scanning both the CLI window and the Workbench for mouse clicks or keyboard I/O at the same time.

To make the most of multitasking, you need lots of memory and fast peripherals. The memory is required to hold every program you'll have running plus what the operating system needs to manage I/O queuing and context switching. Since the display is already handled by the custom chips, the next I/O bottleneck is disk accesses. Of course, a hard disk will speed performance. The Amiga's performance with 1.5 megabytes of memory and a hard disk is superb: I've uploaded files to BIX at 1200 bits per second while doodling in Aegis Images. On another occasion I compiled four programs simultaneously with the Manx Aztec C compiler.

SOFTWARE

It has not yet been a year since the Amiga's release, and already there is an impressive array of programming languages available for it: two BASICs, two C compilers, and two assemblers, along with LISP, Pascal, Modula-2, and FORTH implementations.

The Amiga originally came with Metacomco's ABasiC. However, The machine is now bundled with Microsoft Corporation's Amiga BASIC. Owners who had ABasiC got a free copy of Amiga BASIC with their version 1.1 operating system upgrade. Both interpretive BASICs allow you to access many of the Amiga's graphics libraries. ABasiC opens a single window and behaves like a typical CLI-oriented BASIC with no mouse control and no windows. Amiga BASIC presents you with a command window and a list window. Several menus are available for the mouse user, or you can type commands in the command window. Cut and paste functions are available in the list window. Both BASICs fit neatly into the Amiga's multitasking environment, although you have to adjust the stack size within a CLI window to get ABasiC to operate this way.

There are several MacPaint-style drawing programs that allow you to use the graphics capability of the Amiga to produce color drawings. Graphicraft by Commodore was available at the machine's release date. Electronic Arts released its Deluxe Paint in time for the Christmas season, and Aegis introduced its Images program in the spring. All three programs use an Interchange File Format (IFF) data structure that allows a picture produced by Graphicraft to be read and displayed by Aegis Images or Deluxe Paint. This lets you download pictures from various bulletin boards without regard for which paint program you own.

Aegis provides two programs that give the Amiga serious graphics potential. The first is Aegis Animator, which can read IFF files to generate animated images. It provides a film-splicing capability called storyboarding that can be of use to illustrators or small advertising studios. The second is Aegis Draw, a drafting-style program that allows you to design scale drawings or blueprints, and it comes with a number of plotter drivers.

For business needs, Lattice offers its

Table 1: *Increase in program execution time with a graphics-intensive program running concurrently. Programs were run with Workbench version 1.1 with one CLI window open. Running times are in seconds.*

Programs	Running time	Percent increase
Sieve	6.18	—
Sieve with Boing!	9.23	49
Sieve with Robocity	12.39	110
Sieve with amiga3d	13.38	117



Photo 2: *Multitasking on the Amiga.*

Unicalc Spreadsheet program. I used it for the spreadsheet benchmark timings.

DOCUMENTATION

The Amiga comes with two manuals: *Introduction to Amiga* and *Amiga BASIC*. The introduction manual extensively covers the Workbench side of the operating system. Its strongest point is the information it provides for the slightly nonstandard pin-outs on the serial and parallel ports. The manual's only information on AmigaDOS is a note in the Reference section on how to enter the CLI.

Unless you copy notes out of the developer's manuals at your dealer, you'll probably need to buy *The AmigaDOS Manual* from Bantam Books (1986) for information on the CLI. This book actually contains three developer's manuals: the *AmigaDOS User's Manual*, which covers AmigaDOS commands; the *AmigaDOS Technical Reference Manual*, which describes the disk layout; and the *AmigaDOS Developer's Manual*, which provides useful information for program development.

PERIPHERALS

The peripherals are effective but currently expensive. I used Tecmar's T-card and the 20-megabyte T-disk with the Amiga. The T-card attaches to the expansion slot on the right side of the Amiga and provides an additional 1 megabyte of memory plus a battery-powered clock. The joystick ports are passed to two DB-9 connectors on the front of the unit, and a serial port and hard disk port are located to the rear. The T-disk is small and compact, and it runs quietly. An external power supply feeds both the disk unit and the expansion board.

I installed the T-disk driver easily. Getting the Amiga to recognize the extra memory in the T-card was not so easy: The instruction manual had detailed instructions on configuring the hard disk port and the serial port but nothing at all on the memory setup. It took several tries to determine that it is necessary to select the memory option under the Devices menu, and then explicitly select "install this device" under the Edit menu.

Once properly installed, a script file

The peripherals are effective but currently expensive.

configures the operating system to recognize the additional memory and the hard disk at boot-up. By accident I trashed the hard disk the day after the installation; I've since rebuilt the disk files and have experienced no further problems, and it's been running forty hours a week for over a month.

CONCLUSION

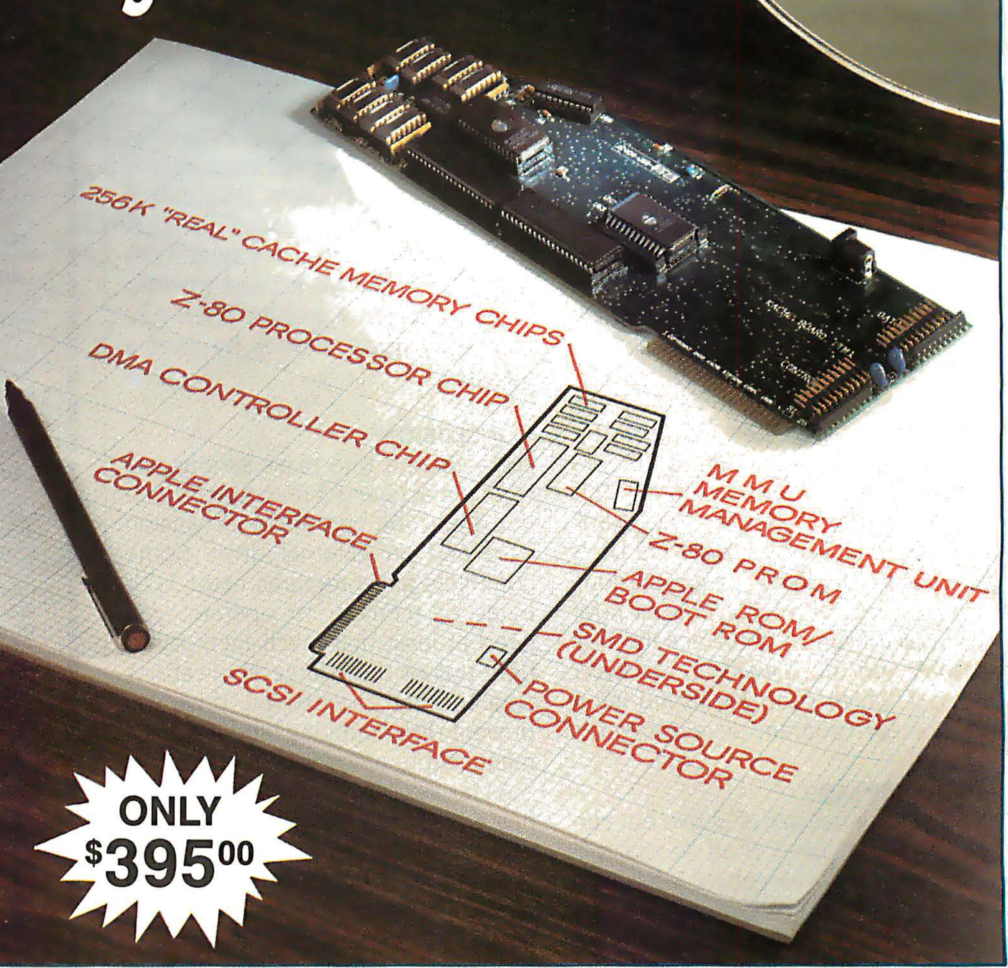
For someone who plans serious use of this machine, I'd recommend getting the 256K-byte RAM expansion card and an external drive. Some compilers and programs need 512K bytes of memory to operate; you need at least that much memory to hold two or three large applications concurrently. The external drive will prevent disk swapping, and it adds a manageable amount of storage.

As far as software goes, the Amiga has a number of useful applications developed for it, with more being released each month. However, if you plan on running a program concurrently with others, try using it on a machine that matches your system to check for possible compatibility problems.

The Amiga is a well-designed piece of hardware. Its expansion bus allows you to add memory or useful peripherals. The Amiga's strong point is its spectacular graphics. I feel confident that the machine will hold its own as a graphics engine for artists and professional illustrators. The only real hardware shortcoming is the high-resolution flicker.

In terms of software, the Amiga has a long way to go. Its multitasking capability is good, but prone to break easily if memory is tight or if a program runs wild. The two operating system interfaces, Workbench and AmigaDOS, have problems. However, if the machine's only real limitation is its software, you can bet that it will get fixed.■

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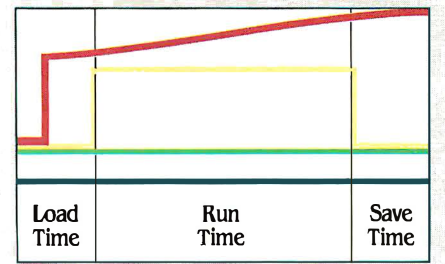
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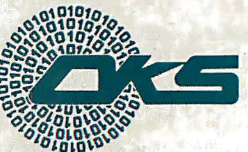
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BY STAN MIASTKOWSKI

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The Compaq Portable II is a slimmed-down version of the Portable 286 with several extras that will particularly attract business users. There are four configurations of the Portable II. The Model 1 includes a single one-third-height 360K-byte floppy disk drive and 256K bytes of RAM; the Model 2 includes two floppy disk drives and 256K bytes of RAM; the Model 3 has a single floppy disk drive, a 10-megabyte hard disk drive, and 640K bytes of RAM; and the Model 4 has a single floppy disk drive, a 20-megabyte hard disk drive, and 640K bytes of RAM. Prices range from $3499 to $4999. The unit I used for this review was a Model 3.



FEATURES

Except for the disk drives and RAM, all four Portable II models are full-featured. In addition to the 80286 processor (running at either 6 MHz or 8 MHz), the system has a real-time clock, an RS-232C asynchronous communications interface, a parallel printer interface, and a built-in 9-inch green phosphor dual-mode monitor that displays both text and graphics. The monitor board provides output for RGB and standard composite NTSC video monitors. It also provides RF modulator output for hooking up the Portable II to a standard television set.

The major selling point of the Portable II is its size and weight. At 7½ inches high by 17½ inches wide by 14 inches deep, the Portable II is almost a third smaller than the original Compaq Portable and the Portable 286. This is a substantial size reduction considering all the computer's electronics.

In addition to size, Compaq designers have also trimmed the unit's weight. Depending on the model, the Portable II weighs between 23½ and 26⅕ pounds. By comparison, the Compaq Portable 286 weighs 30½ pounds, and the Compaq Portable weighs 28½ pounds.

INSIDE THE CASE

With the cover removed, it's obvious that the Portable II is primarily a mechanical and engineering exercise in the reduction of space and weight. The system is modular, and taking it apart is time-consuming, though not difficult. Still, the modular design lends itself to easy upgrading (see below).

Removing a panel at the top rear of the system reveals the expansion slots and part of the motherboard. The Portable II has four expansion slots. Depending on which model you have, the first three-quarter-length 16-bit slot is used by Compaq's floppy-only or floppy/hard disk controller card. The second slot (which is 8-bit) contains a full-length Compaq video board. This leaves two full-length slots for expansion; one is 8-bit, and the other is 16-bit for IBM PC AT–compatible circuit boards.

The video display tube, its associated electronics, and the system power supply are located under another solid panel that should only be removed by computer service personnel. The components there are placed to take advantage of the airflow from the power supply's fan. The fan does a more than adequate job. I left the Portable II on for more than a week and the system never even became warm to the touch. The fan is also very quiet.

Compaq says the power supply is designed for a steady 120-watt load and can handle a peak drain of up to 165 watts. Next to the power supply is a small empty space into which your dealer can install an optional $89 power-switching board that automatically senses whether the Portable II is plugged into 120-volt or 220-volt

(continued)

Stan Miastkowski (P.O. Box 548, Peterborough, NH 03458) is a freelance writer, northeast bureau chief for Newsbytes, *and editor in chief of the* McGraw-Hill Microcomputer Handbook.

Compaq Portable II

Company
Compaq Computer Corporation
20555 FM 149
Houston, TX 77070
(800) 231-0900

Size
7½ by 17½ by 14 inches; Model 1: 23½ pounds; Model 2: 25½ pounds; Models 3 and 4: 26⅕ pounds

Components
Processor: 80286, 6 MHz or 8 MHz (switchable)
Memory: Models 1 and 2: 256K bytes on the main system board; Models 3 and 4: 640K bytes on the main system board; up to 2.1 megabytes without using an expansion slot; up to 4.1 megabytes using the 16-bit expansion slot
Mass storage: Model 1: One one-third-height 360K-byte 5¼-inch floppy disk drive; Model 2: Two one-third-height 360K-byte 5¼-inch floppy disk drives; Model 3: One one-third-height 360K-byte 5¼-inch floppy disk drive and one 10-megabyte hard disk drive; Model 4: One one-third-height 360K-byte 5¼-inch floppy disk drive and one 20-megabyte hard disk drive
Display: Built-in 9-inch green phosphor dual-mode; switchable text/graphics modes
Keyboard: Modified IBM PC AT layout
Expansion: All models: One IBM PC–compatible slot and one IBM PC AT–compatible slot
I/O interfaces: Parallel printer; 9-pin RS-232C interface; RGB monitor; composite NTSC video; RF modulator; light pen

Optional Software
MS-DOS version 3.1: $85

Documentation
Operations Guide
Technical Reference Guide

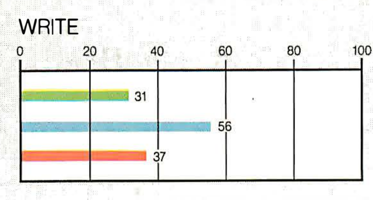
Price
Model 1: $3499; Model 2: $3599;
Model 3: $4799; Model 4: $4999

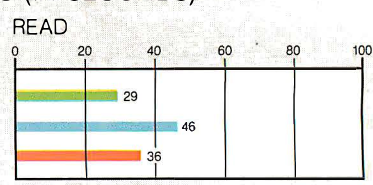
SYSTEM FEATURES



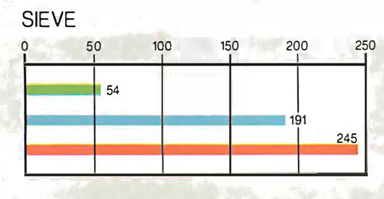


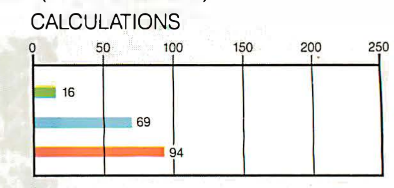
DISK ACCESS IN BASIC (IN SECONDS)



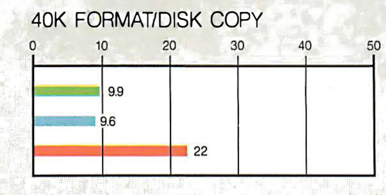


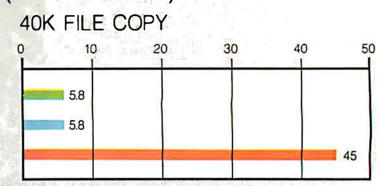
BASIC PERFORMANCE (IN SECONDS)



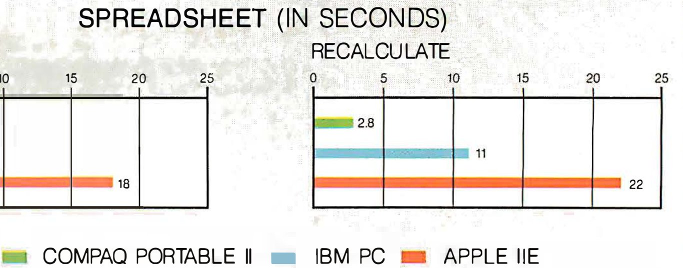


SYSTEM UTILITIES (IN SECONDS)





SPREADSHEET (IN SECONDS)



The Memory Size graph shows the standard and optional memory available for the computers under comparison. The Disk Storage graph shows the highest capacity for a single floppy disk drive and the maximum standard capacity for each system. The graphs for Disk Access in BASIC show how long it takes to write and then read a 64K-byte sequential text file to a blank floppy disk. (For the program listings, see BYTE's *Inside the IBM PCs*, Fall 1985, page 195.) The Sieve graph shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The Calculations graph shows how long it takes to do 10,000 multiplication and 10,000 division operations using single-precision numbers. The System Utilities graphs show how long it takes to format and copy a disk (adjusted for 40K bytes of disk space) using the system utilities. The Disk Copy test measures the time it takes to copy a 40K-byte file from one floppy disk to another. On hard disk systems, the test measures the time to copy from the hard disk to the floppy disk. The Spreadsheet graphs show how long it takes to load and recalculate a 25- by 25-cell spreadsheet in which each cell equals 1.001 times the cell to its left. The spreadsheet used was Microsoft's Multiplan. Tests were run using the default 8-MHz clock speed.

power. This option would be handy for international users.

MEMORY

The 80286 processor is barely visible under the video board; the socket for an optional 80287 arithmetic coprocessor is easily accessible. The rest of the motherboard is hidden under the circuit boards, disk drives, and monitor/power supply case. A total of 128K bytes of RAM is soldered into the board, and there are 18 sockets for RAM chips. In Models 1 and 2, these sockets are filled with 64K-bit chips for a total of 256K bytes of memory; Models 3 and 4 have 256K-bit chips for a total of 640K bytes.

Adding RAM isn't a problem; you simply turn the unit over and remove another panel. There you can insert a special Compaq memory-expansion board that uses a pin connector instead of an edge connector. The board comes with 512K bytes of RAM, and you can configure it for up to 1536K in 512K increments without tying up an expansion slot. You can also upgrade the unit to 4.1 megabytes of RAM by installing a 2048K-byte Compaq memory-expansion board into the 16-bit expansion slot.

KEYBOARD

Compaq describes the Portable II's 84-key keyboard as having a modified IBM PC AT layout. The full-size keyboard is compact because the function keys are at the top rather than on the left. You can adjust the audible key clicks from full volume to off.

DISKS

The Model 3 that I reviewed had a single 360K-byte floppy disk drive and a 10-megabyte 3½-inch MiniScribe hard disk drive. The hard disk "floats" on four small rubber shock mounts that are designed to cushion the hard disk. I accidentally dropped the machine 2½ feet onto a carpeted floor. The case wasn't marred, and the g forces of the impact were well absorbed by the shock mounts. The Portable II worked perfectly after the drop.

EXPANDABILITY

The Portable II is easy to upgrade. With the exception of the automatic power-switching board, which must be installed by an authorized service center because of Federal Communications Commission and Underwriters Laboratories regulations, you can easily upgrade the Portable II yourself. Because of all the screws, panels, and parts that you must remove, the process may be time-consuming, but the Portable II's *Operations Guide* has excellent instructions complete with copious photographs for both disassembly and reassembly.

If you have a single-drive Model 1 you can easily add a second 360K-byte floppy disk drive or a hard disk. The most time-consuming task is upgrading the motherboard RAM from 256K to 640K on a Model 1 or Model 2. The change requires you to remove expansion boards and the standalone enclosure that holds the disk drives and replace eighteen 64K-bit RAM chips with 256K-bit chips. Compaq charges $150 for the 512K-byte chips.

PERFORMANCE

As you might expect, the Portable II runs software very quickly, especially when you use the default 8-MHz clock speed. Compaq includes a list of several hundred software packages that run on the Portable II. I tested a dozen different programs, some of which were not on the list. I had no problems whatsoever. All ran at 8 MHz.

You might expect that the 105-millisecond access speed of the 3½-inch hard disk drive would provide slow performance compared to the 30-millisecond access speed of the full-height hard disk in the Compaq Portable 286. However, the BYTE Disk Access benchmarks showed very little difference (see page 240).

I found it hard to adjust to the 9-inch green phosphor screen, perhaps because I am used to a full-size monitor. I had to sit closer to the screen than I normally do. I also found that the adjustable feet that tilt the Portable II upward were not sufficient on a standard-height desk. I finally placed the machine's documentation underneath the monitor to provide a better viewing angle. In addition, the two adjustable feet are so sharp that, with the weight of the entire system resting on them, they gouged my teak computer table. I recommend placing the system on a harder work surface.

SOFTWARE

The only software that comes with the Portable II is a demonstration disk that gives an animated, graphics-filled introduction to the system's features and options. Compaq sells MS-DOS version 3.1 for $85. In addition to the usual utilities and BASICA, MS-DOS version 3.1 includes several custom utilities. One utility controls the volume of the keyboard clicks; another regulates the speed of the processor. You can control these functions by pressing a series of keys, but the utilities allow you to control the functions by using batch files. The MS-DOS disks also include an extensive diagnostics program. The tests fully check out the system, but they use cryptic test numbers with no in-progress messages.

DOCUMENTATION

The Portable II comes with an *Operations Guide*. It is a bit short on detailed information, although it is expensively produced and full of photos. The sections on upgrading the system are particularly well done. The *Technical Reference Guide* may be available by the time you read this review.

The MS-DOS manuals are complete rewrites of the IBM PC versions. They're much improved and do an excellent job of explaining the intricacies of the more esoteric MS-DOS commands.

SUMMARY

The Compaq Portable II is solidly constructed and compatible with the vast majority of software that runs on IBM PC systems. Though far from forging any new technological ground, it's a fine example of how modular design can provide a compact, full-featured system that is easy to expand and service.

Unfortunately, the price of the Portable II is very high. But if you can afford the price and want the portability, you won't go wrong with the Portable II. ■

HERE'S THE DEAL:



$895



$1695



$599

VISO

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- FULLY IBM-PC COMPATIBLE
- MS-DOS 3.1
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- RGB AND COMPOSITE MONOCHROME OUTPUTS
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- WEIGHS 11 POUNDS
- ONE 5 1/4" FLOPPY DISK DRIVE

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- MONOCHROME OR RGB MONITORS
- 640K RAM
- HANDSOME CARRYING BAG

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- SOFTWARE-SELECTABLE 8- OR 6-MHz CPU SPEEDS
- MS-DOS 3.2 AND GW BASIC
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- ONE 1.2 MB FLOPPY DRIVE
- SIX AT SLOTS AND TWO XT SLOTS
- 84-KEY AT-STYLE KEYBOARD
- 192-WATT POWER SUPPLY
- REAL-TIME CLOCK

160T

"TURBO"

SERIES MPC-160T

- IBM PC/XT COMPATIBLE
- SOFTWARE SELECTABLE 8/4.77 MHz CPU
- MS-DOS 3.2
- 640K RAM
- ON-BOARD FLOPPY DISK CONTROLLER
- ONE 5 1/4" FLOPPY
- 84-KEY AT-STYLE KEYBOARD
- 135 WATT POWER SUPPLY
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Four ¼-inch Tape Backup Units

BY MALCOLM C. RUBEL

Four backup systems that have a variety of features and capabilities

Hard disk technology has progressed to such an extent that you can purchase a 20-megabyte disk drive on an expansion card or a 140-megabyte disk drive for under $3300. To enter this world without data backup is to invite disaster. A ¼-inch cartridge backup system provides one of the best alternatives for averting catastrophe. I will compare two QIC (Quarter-Inch Committee) 60 drives, the Tecmar QIC-60 and the Sysgen Smart QIC-File, to the Tallgrass TG-4060, which uses the PC/T (Personal Computer Tape) standard, and the Alloy FT-60, which uses its own storage protocol. Testing was done on an IBM PC AT with 512K bytes of memory and a Priam 60-megabyte hard disk with a 30-millisecond average seek time.

For a look at an alternative to traditional tape backup systems, see the text box "Alpha Microsystems' Videotrax—A VCR Alternative?" on page 246.

STARTING UP

Setting up the tape backup units was not difficult. The biggest problem installing the units was removing the five screws from the back of my IBM PC AT. All four units require a controller board, and all but the Alloy board will fit in a short slot. (Note that the Alloy system doesn't require the optional $195 controller card if you use it with a standard IBM PC or XT, as it will run on the external connector of the floppy disk controller.)

The power arrangement for the Sysgen unit was less than satisfactory. As part of its automatic backup philosophy, the unit takes power from the system power outlet so that it is turned on with the computer. The stiff piggyback connector does not make good contact, so Sysgen supplies an extra cable to be used between the system unit and the faulty plug. I wish Sysgen had simply redesigned the plug instead of adding yet another cable to the back of my machine.

The Tallgrass unit is the only one that is too large to sit on top of the computer next to the monitor. The Alloy and Tallgrass units use round cables instead of the thick and nearly unbendable ribbon cables used by the other two units.

I had no problems with any of the user's manuals. I found that I could start using each system with only a minimal time investment.

OPTIONS

With the exception of the Sysgen unit, you can get a hard disk drive as an extra-cost option with your unit. Tecmar has a 20-megabyte option, Alloy offers 20- and 40-megabyte drives, and Tallgrass has 25-, 35-, 50-, and 80-megabyte options. The Tallgrass drives run from the same controller board as the tape unit, but the Alloy and Tecmar systems require a separate card for their hard disks. Tecmar also offers its tape drive as an internal unit for the IBM PC AT.

FEATURES

All four systems provide for image backup/restore, file-by-file backup with the backup of modified files, and backup using wild cards, hidden files, and files in subdirectories as options. All the units except the Tallgrass TG-4060 allow you to specify a date and back up only the files created or modified after that date. All the units allow you to get a directory listing of what is on the tape.

With file-by-file backup, all the units allow you to restore either whole directories or specific files and recreate subdirectories if necessary. The Tecmar unit will restore an image backup to a different disk drive with bad sectors as long as the new drive has the same or a greater number of good sectors.

All four units come with software that has a command language used to control the operation, and all but the Tallgrass unit also offer a menu-driven program. The menu programs are not suitable for anything but the simplest procedures, and I quickly went to the command language with each of the units. You can build batch files with each of the drives to make repetitive backup procedures easier. The Sysgen and Alloy drives even allow you to back up automatically at specified times, should you so desire. I would prefer writing a batch program to invoke a backup session before leaving my computer rather than having the session start just as I was about to do some time-critical work on a spreadsheet model.

(continued)

Malcolm C. Rubel is president of Performance Dynamics Associates (305 Madison Ave., New York, NY 10165). He is also coauthor of The Performance Guide to Word Processing Software.

Name	QIC-60	Smart QIC-File	FT-60
Type	60-megabyte ¼-inch tape backup drive (QIC 60 standard)	60-megabyte ¼-inch tape backup drive (QIC 60 standard)	60-megabyte ¼-inch tape backup drive, driven from floppy controller
Company	Tecmar Inc. 6225 Cochran Rd. Solon, OH 44139 (216) 349-1009	Sysgen Inc. 47853 Warm Springs Blvd. Fremont, CA 94539 (415) 490-6770	Alloy Computer Products Inc. 100 Pennsylvania Ave. Framingham, MA 01701 (617) 875-6100
Size	7 by 4 by 16 inches	2 by 6 by 10 inches	6 by 5¼ by 16½ inches
Necessary Hardware	IBM PC or compatible; 256K bytes of RAM (to be menu-driven); 192K bytes of RAM (command-driven); one open expansion slot	IBM PC or compatible; 192K bytes of RAM; one open expansion slot	IBM PC or compatible; 256K bytes of RAM
Options	20-megabyte hard disk drive; internal mount (for the IBM PC AT)	None	20- or 40-megabyte hard disk drive; controller card (for IBM PC AT)
Documentation	130-page spiral-bound installation and operations manual	170-page installation and operations manual, sized to fit IBM-type binder	55-page spiral-bound installation and operations manual
Price	$2144	$1495	$995

All four units use the standard DC 600A tape (600 feet long, ¼ inch wide), and all hold roughly 60 megabytes of information. Except for the Sysgen unit, each unit's tape has to be formatted before use, and the Tecmar tapes have to be reformatted every time you reuse them. In contrast, once you've formatted the Tallgrass and Alloy tapes, they can be reused indefinitely.

Real-World Use

Everyone's working environment is different, so I did not attempt to emulate any specific environments in my benchmark tests. You can more easily approximate the capabilities of the different units for your specific needs by interpolation of the results of the several benchmark tests.

Unlike floppy disks, magnetic tape is a serial storage medium. It takes more time to get to a specific point on a tape than it does on a disk simply because a greater distance must be covered. Just to get from one end of a DC 600A tape to the other at 90 inches per second (a fast speed for tape) takes 80 seconds, a long time for those who are used to access times measured in milliseconds. How each manufacturer deals with this makes a big difference in how its unit works in the real world.

In storing data, two different approaches are used. The Tecmar and Sysgen units conform to the QIC 60 standard and write each backup session in a volume, which is headed by a directory for that volume. Each volume starts where the last one left off, so the time required to read or write data increases as a tape reaches its capacity. Because of this arrangement, I had to wait for three or more minutes to get directory listings from a tape that was 25 percent full.

The Tallgrass and Alloy units, on the other hand, each use their own type of disk directory that contains all the necessary information at the beginning of the tape. Files can be directly accessed from there, saving a considerable amount of time.

If you are only going to use tape as a protection against disk failure, the two QIC 60 units provide the best backup speed. The Tecmar drive is superior to the Sysgen model for two reasons: It is much faster at backing up selected files (either modified or time-specified), and it will accommodate 256 backup sessions on a single tape compared to the Sysgen unit's 64 sessions.

TG-4060	Videotrax
60-megabyte ¼-inch tape backup drive (PC/T standard)	Approximately 20-megabyte VCR tape backup unit (proprietary format)
Tallgrass Technologies Corporation 11100 West 82nd St. Overland Park, KS 66214 (913) 492-6002	Alpha Microsystems 3501 Sunflower Ave. Santa Ana, CA 92704 (714) 957-8500
5¼ by 9 by 13¼ inches	4½ by 17 by 14 inches
IBM PC or compatible; 256K bytes of RAM; one open expansion slot	IBM PC or compatible; 256K bytes of RAM; one open expansion slot
25-, 35-, 50-, and 80-megabyte drives	Customized VCR unit
154-page installation and operations manual in three-ring binder	150-page installation and operations manual, loose pages to fit IBM-type binder
$1995	$595 for controller board and software $1395 for complete system

If you lack the discipline to type BU to initiate a backup batch file, the Sysgen unit with its automatic backup feature is probably better for you. If, however, you do not want to use the automatic backup procedures, you have to get rid of the AUTOEXEC.BAT file that the installation creates and figure out how to invoke the backup program for your needs. Sysgen assumes that everyone will want to back up their data automatically, and the accompanying information on manual operation is sparse.

The Tallgrass unit uses the PC/T protocol. The system operates more like a disk drive than a tape unit. The directory is at the beginning of each tape volume and, unlike the other units, when you update an existing file, the older version of the file is overwritten. This makes restoring a file from tape much easier, since only the most recent update is on the tape.

The Tallgrass software allows you to get directory listings of your hard disk drive and the tape volumes; make, change, and remove directories; rename and delete files in existing tape volumes and drives; print a file; and show directory trees. These operations, not unlike their DOS counterparts, make PC/T a more flexible tape standard than the others I tested. [*Editor's note: Tallgrass has recently announced version 2.1 of its tape backup software, which lets you run applications from the tape in the event of a hard disk crash. The software evaluated in this review is version 1.3.*]

DRAWBACKS

The Tecmar QIC-60 does not allow you to stop a backup in progress. If you do stop the backup procedure, you have to erase the entire tape before you can back up additional data. Also, you cannot delete data selectively; instead, you must erase the entire tape. This means that you must use two tapes to ensure data security. The software looks for COMMAND.COM in drive A, which is a strange place to look when you have a hard disk system. In addition, the fan on the Tecmar unit is the noisiest of the systems I tested.

The Sysgen Smart QIC-File, with its 64-session limitation, may cause problems in some circumstances. I did not like the way the automatic backup software worked. The software is designed to be foolproof, but it has too many places where a person can cause damage to the system. For instance, if you have the wrong tape in the drive when you turn on the machine, the backup program asks you if you want to delete all the information on the tape so that the tape can be used. If you mistakenly say yes, you could delete the only copy of information just removed from disk to tape. Like the Tecmar unit, Smart QIC-File is slow at showing directories.

The Alloy FT-60 is not speedy, as the benchmark tests show. This is because the unit performs a separate verification pass over the data during the backup procedure. Restoring data using wild cards is even slower because the search continues to the end of the recorded tape for more files. When you restore a single file, the search stops at the first occurrence of the file. If you have a later version of that file, it will not be restored unless you specify the proper backup session number.

As with the QIC 60 units, the Alloy FT-60 does not let you delete files selectively; you must erase all data on the tape. Also, the unit will not let you restore files to a different drive. For example, a file backed up on drive C cannot be restored directly to drive D.

The biggest problem with the Tallgrass TG-4060 is that you are limited by directory size to 509 files in a tape volume. This is not as bad as it seems because a tape can be used either as a single volume of 60 megabytes or

(continued)

as four separate volumes of 11 megabytes each, with a fifth volume of 16 megabytes. The directory size limitation (if it exists for your situation) can be dealt with by carefully selecting directories and subdirectories to be backed up in each of five tape volumes. A 2500-plus file limit is far less restricting.

DATA INTEGRITY

The only data problem I encountered was with the Alloy FT-60. The unit blocked off bad sectors when it formatted the tape (just as DOS formats a floppy disk), but during my first practice session the tape verification pass indicated there were bad blocks within some files and that the system was rewriting the suspect files at the end of the tape. When I checked the rewritten files, I found that although the filenames were right, the actual files had not been copied; two duplicates of the last file in the directory had been written instead. Since the newly found bad blocks were now reserved, I did not get this error again. Five phone calls to Alloy finally put me in contact with the technical people, who had no explanation.

The other three units performed without a hitch through all the testing. The Tecmar and Sysgen units immediately rewrote the data block if there were any problems. The Tallgrass unit provides data security through automatic error correction, a three-part data block structure that includes a

ALPHA MICROSYSTEMS' VIDEOTRAX—A VCR ALTERNATIVE?

Alpha Microsystems' Videotrax is an alternative to traditional tape backup systems. Videotrax comes in two parts: a controller card and a VCR unit. You can buy the controller card separately for $595 and use your own VCR unit, which you must operate manually, or you can purchase the system complete with a VCR for $1395.

The idea of being able to store up to 80 megabytes of information on a $5 video cartridge is very appealing. Unfortunately, the appeal and the reality are two different things.

To begin with, Alpha Microsystems acknowledges that you should record at the fastest possible tape speed to ensure better data integrity. The company also gives a specific warning about using the ultra-long-playing mode. A two-hour tape playing at normal speed and making a file-by-file backup with the data security default of 10 rewrites (see below) will hold between 10 and 30 megabytes of data depending on the number of files you are backing up. The greater the number of files, the lower the total storage capability of the unit will be.

Videotrax's menu-driven backup software allows you to back up several drives or directory sets in a single session, but you can record only one backup session on a tape. When you use the tape again, the unit writes over existing information.

The unit compensates for the inherent unreliability of VCR recordings by writing each data block from 4 to 40 times with a default value of 10 rewrites. The more rewrites there are, the less information a tape will hold but the less chance you will have of any hard (unrecoverable) errors.

Compared to traditional tape backup units, Videotrax is slow. I ran the benchmark tests on the Videotrax unit using the same evaluation files used for the four ¼-inch units. The results are shown in table A. Compare these times to those for the tape backup units in table 1.

Although the Videotrax unit will back up modified files, it will not do this on the same tape as the master set. You have to use a separate tape for this. With this approach you can quickly run up a big tape bill.

The Videotrax software offers you the option of verifying that the information you have written to tape can be read, but this option does not actually compare the tape to the disk files. In additon, using it increases the backup time by a factor of two.

To back up 80 megabytes of data with Videotrax, you would need just a few large files and record on long play. The backup session would last four hours. An alternative would be to reduce the number of data rewrites, but that would increase the probability of hard errors.

When you start using a new tape, the Videotrax manual strongly advises you to certify the tape. Tape statistics at the end of the certification include hard errors and soft (recoverable) errors. Data will be lost if there are hard errors. It takes four hours to certify a 120-minute tape.

Alpha Microsystems also suggests that you calibrate the VCR unit before using it, to optimize performance. The calibration process takes two and a half hours but is worthwhile. If you do not take the time to do this, or if you are using your own VCR, you will have to manually work the controls to find files to restore.

In conclusion, I cannot recommend the Videotrax unit as an alternative to traditional tape backup units because, at $1395, the system is not much less expensive than many of the better (and faster) alternatives.

Table A: *Benchmark test results for the Videotrax backup unit. Times are in minutes:seconds.*

	Backup time	Restore time
200 1K-byte files	9:23	9:06
200 10K-byte files	14:42	14:18
20 100K-byte files	7:13	7:01
2 1000K-byte files	6:30	6:17
422 files (6.2 megabytes)	39:30	37:01

parity block to allow for automatic reconstruction of unreadable data. The program also allows for a verification pass on all backups. If you specify this option, the times are doubled.

Of the units tested, the Tallgrass unit seemed to have the best data security system. Other than the Alloy problem, I experienced no data errors in any of my testing.

STANDARDS AND COMPATIBILITY

Probably the only thing that can be said about standards and compatibility is that they do not exist. The QIC standard deals only with how data is written onto a tape, not with how that data is read once there. The marketing people at each company differentiate their product from the others through software features that make the data recorded on their unit functionally useless on a different machine. The Sysgen tape, for example, was unreadable in the Tecmar unit and vice versa.

The Alloy FT-60 uses its own type of directory and formatting to store and retrieve data. The PC/T standard on the Tallgrass TG-4060 stores roughly the same 60 megabytes per tape as the Alloy unit, but it uses 11 tracks and a completely different data format. As the PC/T protocol is more like an operating system, a tape formatted on one machine should be able to run on any other that uses this system, but it probably won't.

Beyond these standards lie many others. Recently the QIC approved a standard for 120 megabytes on a DC 600A cartridge. There are new standards for DC 1000 tapes and for backing up using floppy disk controllers. Some companies have "proprietary standards" (whatever that means).

If you are interested in moving data from one tape unit to another (i.e., using the same tapes in two different units), you would probably be wise to buy two or more units of the same make and model. It would also be wise to make sure that the tape is readable between the units, since things like head alignment might still give you data-reading problems.

BENCHMARK PROCEDURES

A series of five different sets of files were used to perform the benchmark tests. The five file sets do not attempt to model any specific use, but were constructed to give meaningful data points that each individual can interpret for a specific situation.

Each of the first four file sets contained identical files of 1K, 10K, 100K, or 1000K bytes. The last set consisted of the first four sets combined. The first and second sets contained 200 files each, the third contained 20, the fourth had 2, and the last set had 422 files, for a grand total of 6.2 megabytes.

I performed three tests on each of the file sets. Each set of files was backed up in order on a single tape in separate operations. The hard disk files were then erased and the file sets were individually restored from tape. Every tenth file was then modified by 1 byte, and the backup tests for each of the modified data sets were then performed on the same tape. The last set of files (6.2 megabytes) was not tested for modified files.

Table 1: *Results of benchmark tests performed on the four tape backup units. Times are in minutes:seconds.*

	Tecmar QIC-60	Sysgen Smart QIC-File	Alloy FT-60	Tallgrass TG-4060
Tape speed (inches per second)	90	90	39	75
Number of tracks	9	9	12	11
Tape format time	2:52	N/A	84:30	116:00
200 files, 1K byte each				
Back up	1:21	3:15	2:15	1:27
Restore	2:10	9:20	10:30	2:05
Back up changes	3:25	2:27	3:36	1:00
200 files, 10K bytes each				
Back up	2:33	2:53	5:21	5:11
Restore	3:40	5:03	9:40	11:10
Back up changes	1:03	3:29	3:55	3:47
20 files, 100K bytes each				
Back up	2:31	2:45	7:50	3:36
Restore	2:23	2:44	9:25	3:45
Back up changes	0:57	3:22	4:00	3:02
2 files, 1000K bytes each				
Back up	3:19	3:30	6:41	3:18
Restore	2:58	3:31	8:17	3:19
Back up changes	1:16	3:38	6:13	1:50
422 files, 6.2 megabytes total				
Back up	7:05	10:09	15:15	14:09
Restore	14:56	19:06	19:42	24:08
File access times				
Minimum time to restore 1 file	0:16	0:27	0:46	0:11
Maximum time to restore 1 file	3:04	4:22	3:40	3:35

The minimum time to restore a file was the time that it took to restore the first file on the tape. The maximum time was determined through trial and error. See table 1 for complete benchmark results.

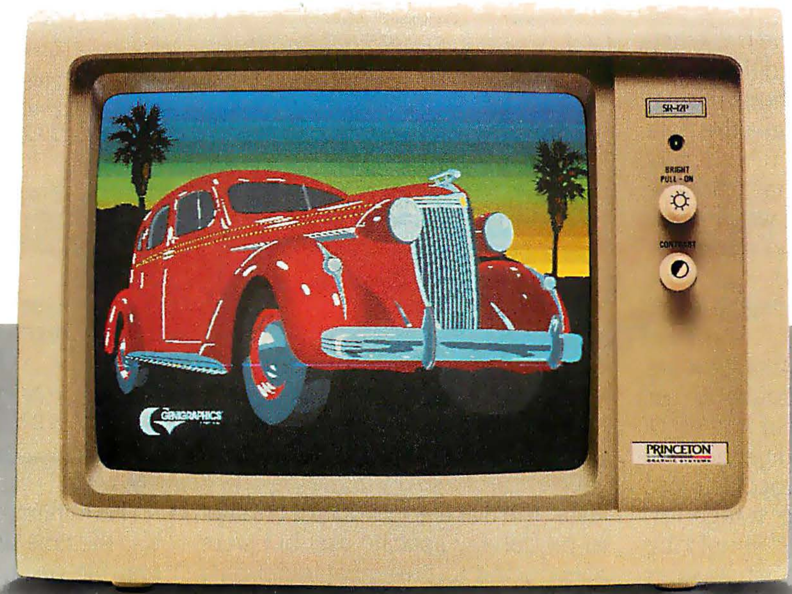
CONCLUSIONS

The environment in which you use a tape backup unit really determines which of the four units reviewed here would be most suitable for your needs. For raw speed, the Tecmar QIC-60 unit is the winner. If a system is to be operated by inexperienced users, the Sysgen Smart QIC-File's automatic backup feature might make it a better choice. If money is a serious concern, the Alloy FT-60, while short on speed, is the least expensive unit. My preference, however, for all-around flexibility and data integrity, is the Tallgrass TG-4060. While it is not the fastest unit, it offers more capabilities for more varied operating environments than the other units. ■

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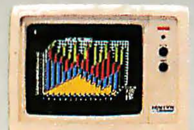


















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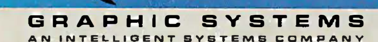
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Inquiry 241

MULISP-86

BY ROBERT J. SCHALKOFF

A customizable LISP *with recent enhancements and an optional compiler*

The muLISP-86 LISP development system is the successor to muLISP-83 (see "LISP for the IBM Personal Computer" by Jordan Bortz and John Diamant, July 1984 BYTE) and the short-lived muLISP-85. In fact, muLISP-86 is very similar to muLISP-85, the principal differences being that muLISP-86 has a revised and updated manual and an optional compiler. It is worth noting that muLISP-86 is produced by Soft Warehouse, but it is identical to Microsoft LISP. This review looks at muLISP-86 as compared to muLISP-83 and as a subset of Common LISP.

SYSTEM OPERATION

You invoke the muLISP-86 development system from DOS via the command A>mulisp <sys-config>, where sys-config is the name of a system file containing your customized development environment (i.e., the editor, Common LISP library functions, the help facility, and perhaps the debugger). The muLISP-86 system contains over 300 primitively defined functions and control variables that comprise the so-called pure LISP. Function and macro libraries, which consist of additional Common LISP and InterLISP subsets, respectively, are included as files of pure LISP source code. The Common LISP library contains over 60 additional functions. Thus, you can achieve either Common LISP or InterLISP programming functionality by loading the appropriate library files. For example, the LISP-assignment functions set and setq are primitive functions in muLISP-86 and are loaded into user memory when you execute the MULISP.COM file. The extremely general and useful setf function, on the other hand, is contained in the Common LISP library (COMMON.LSP), which you have to load separately. In addition, to implement Common LISP arrays you have to load both the Common LISP library and a separate library of array-manipulation utilities (STRUCTUR.LSP).

You can easily customize the muLISP-86 development system to suit your needs. For example, you could read the editor and an appropriate subset of one or more library files (your own or those supplied with the program) into the muLISP environment and then save them as one .SYS file that you can load more quickly thereafter. By not loading and saving the entire set of library files, you can save memory for program development.

The updated muLISP-86 development system contains a useful windows feature. Following the opening menu, you can split the screen into two windows and observe LISP source code in one window, the editor window, and the muLISP-86 interpreter (the so-called read-eval-print function) in the other window. A single keystroke lets you invoke the interpreter. To get from the eval loop to the editor, you simply hit Return at the interpreter prompt. The windows are particularly useful for tracing functions and developing programs incrementally.

A consequence of this new editor-based development system (in contrast to the menu-driven muSTAR development system that accompanied muLISP-83) is that to achieve incremental program development you have to edit functions as separate files, or create a continuously expanding file, and you must explicitly invoke the trace and debug facilities (as described below). For learning LISP, I prefer muLISP-83's menu-driven environment.

THE MULISP-86 EDITOR

You can configure the muLISP-86 editor to look like either WordStar or (for those who have used one of the MacLISP variants) EMACS. While both muLISP-86 configurations represent subsets of the full editors, they nevertheless support the functions you are most likely to use. You can also customize either editor to map familiar keystrokes into editing functions.

Furthermore, both muLISP-86 editors have several handy extensions that aid in editing LISP symbolic expressions. One extension is for the s-expression, which is the basic entity manipulated by LISP and essentially consists of atoms and lists. The editors' list-structure commands are keystroke combinations that move the cursor around s-expressions and lists in the same way that WordStar and EMACS move the cursor around characters, words, and lines. For example, in the WordStar-like editor mode, Esc-D and Esc-S move the cursor forward one s-expression and backward one s-expression, respectively. Other keystroke combinations let you delete and evaluate s-expressions. Since the majority of LISP program editing and

(continued)

Robert J. Schalkoff (Department of Electrical and Computer Engineering, Clemson University, Clemson, SC 29634-0915) is associate professor at Clemson University, where he conducts research in image processing and artificial intelligence.

muLISP-86

Company
Soft Warehouse Inc.
3615 Harding Ave., Suite 505
Honolulu, HI 96816
(808) 734-5801

Type
Programming language

Computer
IBM PC, XT, AT, PCjr, or compatible; MS-DOS-based systems; 128K bytes of RAM minimum (256K bytes recommended); one floppy disk drive (two floppy disk drives recommended)

Documentation
400-page muLISP-86 reference manual; *Soft Warehouse Newsletter*, 3 issues

Price

Interpreter	$250
Optional compiler	$150
Interpreter with optional compiler	$350

debugging involves modification of s-expressions, this editing utility is quite convenient.

The muLISP-86 editor also provides two other handy features for creating and modifying LISP code. One is the superparens (]), which automatically inserts closing parentheses and relieves you of keeping track of the number of opening parentheses. This feature is often found in larger LISP implementations and, while convenient, can be dangerous since it eliminates the need for you to check the s-expression structure in determining the number of closing parentheses.

Another handy feature is blinking matching parentheses. In the edit mode, moving the cursor to a left parenthesis causes the corresponding right parenthesis, if it exists, to blink (and vice versa), thus providing an immediate visual display of the contents of the s-expression. You can use this feature to quickly identify an incorrect program-control structure such as a missing parenthesis or one that is incorrectly placed.

The revised editor in muLISP-86 comes up in the WordStar-like insert mode as opposed to the muLISP-83 editor, which assumed overwrite mode. If you forgot to change the muLISP-83 editor mode prior to editing (as I often did), you could overwrite large amounts of code before realizing the effect. Other changes are not as welcome. For example, the muLISP-86 editor does not retain the pretty-print feature of its predecessor. This feature displays the source code with the control structure delineated by indentation and provides a quick visual display of the program structure.

ERROR HANDLING AND PROGRAM TERMINATION

The muLISP read-eval-print error handler is called the Break Package. When the interpreter discovers an error, it displays a short message such

as "File not found" and then prompts you to type continue, break (temporarily suspend program execution and call the read-eval-print loop on the next level down), abort (abort and return to the most recent read-eval-print loop), top-level (abort and return to the top-level executive driver loop), restart (initiate a new muLISP system—the approach to use when all else fails), or system, which returns you to DOS.

DEBUGGING FACILITIES

In addition to the Break Package, muLISP-86 provides a comprehensive set of functions to allow efficient debugging. Foremost among these is the trace function. This function indicates the level of the function call and the names and bindings of the function arguments at this level. The trace function also lets you redirect the output to a file. This is often necessary due to the voluminous amount of output of some programs where several functions may recursively call each other.

The muLISP system follows the Common LISP convention of delineating single-line comments with one or more semicolons. If you wish to have multiple-line comments, you can use the primitive function comment, which holds the comment by inhibiting the evaluation of its arguments.

DISTRIBUTION MEDIA

The distribution disk for MS-DOS systems includes the executable muLISP interpreter file (MULISP.COM); the editor (EDIT.LSP); a help file (HELP.LSP); library files containing InterLISP and Common LISP functions, macros, and special forms (INTERLIS.LSP, COMMON.LSP, and STRUCTUR.LSP); a six-lesson interactive tutorial (MULISP1.LES to MULISP6.LES); a .COM to .EXE file converter (COMTOEXE.COM); the source code for the debug and trace facilities (DEBUG.LSP); some sample programs such as the Tower of Hanoi; and a file for function redefinitions to achieve compatibility with muLISP-83 (MULISP83.LSP). This file is handy since muLISP-83 contains a large number of function names that are incompatible with MacLISP and Common LISP. The optional compiler is written in muLISP and distributed on a separate disk consisting of four files.

The compact size of the muLISP-86 system (MULISP.COM, the editor, and the Common LISP library files take a little more than 100K bytes) makes it suitable for use on floppy-disk-drive-based systems. This is in contrast to other LISPs such as Golden Common LISP, which comes with five distribution disks and practically necessitates a hard disk drive.

The muLISP-86 disk is not copy-protected, in contrast to Golden Common LISP, which contains a sophisticated copy-protection scheme and a corresponding installation and de-installation procedure. In fact, the muLISP-86 license agreement seems to foster the distribution of the product on a trial basis by stipulating that "the software shall be run on at most five computers residing in a single building or facility" and that the "end user is authorized to allow temporary use of the software by the end user's family, employees, consultants, or students."

COMMON LISP COMPATIBILITY

Although muLISP-86 does not attempt to implement the entire LISP standard, this is not a serious limitation since it is neither practical nor necessary for a useful LISP development system that is used on a personal computer to adhere strictly to this standard. In fact, this is currently impossible with an interpreter. The muLISP-86 system implements a subset of the advanced control constructs that are popular in Common LISP. For example, you can replace the historically standard cond function with if functions that more closely resemble other high-level languages. In muLISP-86, if is a primitively defined special form. The COMMON.LSP library file supports other popular constructs such as the when macro and the more advanced let and let* (the sequential version of LET). In addition, muLISP-86 supports user-written macros and some advanced Common LISP constructs such as defstruct (in the STRUCTUR.LSP library file). Unfortunately, other constructs such as packages and block are not implemented in muLISP-86.

Like most LISP implementations (including Golden Common LISP), muLISP-86 is dynamically scoped (i.e., the value bound to a variable is the one most recently assigned to it). Furthermore, in muLISP-86, variables bound to functions (i.e., appearing in the function definition as formal parameters) become local variables within the scope of that function. Otherwise, variables are considered global in scope; therefore, any assignments made during the execution of a function remain in effect after the function is exited. This is known as a side effect and is not necessarily bad.

DISK SPACE, MEMORY USAGE, AND GARBAGE COLLECTION

Garbage collection (elimination of data entities that are no longer useful, thus conserving memory space) is automatic and quick, taking about one second. The muLISP-86 system provides a primitively defined function (reclaim) and a corresponding control variable to let you monitor the frequency of garbage collection, memory allocation, and the amount of free memory. Checking this is sometimes useful when a program's execution seems to be slow, since the system may be consuming the majority of its time in garbage collection, an undesirable process known as thrashing.

The muLISP-86 system, like muLISP-83, is fast due to its use of distilled code (d-code). The use of efficient storage techniques and d-code makes it possible for you to load the muLISP interpreter, a choice of editor, the Common LISP library, and the debug routines into RAM and still have ample space for program development. On my 256K-byte system, even with space allocated for the resident portions of DOS 2.10, the reclaim function indicated that I had over 100K bytes free, a substantial amount of space for program development. If this amount of memory was insufficient, I could have extracted the functions I normally use from the Common LISP and debug libraries and saved them in a new smaller library that would take up less of the system RAM. This is in sharp contrast

(continued)

to the documented operation of Golden Common LISP, wherein the system and editor leave only 20K bytes remaining for program development in a 512K-byte system.

I/O

The muLISP-86 system accepts input from either the keyboard or a disk file via the rds (read select) function. The system also provides several typical printing functions (print, princ, and prin1) and the ability to handle string variables. The system supports both list and dot notation.

THE COMPILER

Program development in a language such as LISP normally proceeds in interpreted mode with the incremental development and debugging of functions. Once these functions are fully debugged, however, you can use the optional muLISP-86 compiler to significantly improve the execution speed of application programs by transforming functions into native machine code.

You can also use the muLISP-86 compiler to individually compile user-defined functions (the so-called "incremental compiler" mode). Alternately, you can use the compiler in a file compiler mode where all the functions in a file or set of files are compiled. Either mode requires that you load the compiler source code, which takes additional memory. On my system, the loading of the incremental compiler required approximately an additional 45K bytes of RAM.

DOCUMENTATION

The muLISP-86 documentation is a slightly revised version of the muLISP-85 documentation. It consists of a single binder with approximately 400 pages. It covers the major system features, muLISP tutorials, data structures and memory management, a comprehensive summary of the muLISP-86 functions, the debugger and editor, the optional compiler, and the machine-level access functions.

The documentation is a welcome revision of earlier counterparts. The operation of primitively defined muLISP functions is well documented. The manual also contains (as does tutorial lesson number 3) a good discussion of the concept of a cons construct for internal computer representation of lists and the relationship of lists to binary trees. For quick reference, the manual has separate indexes for concepts and muLISP functions. A particularly good feature of the documentation is an appendix that details source file conversion from muLISP-83 to muLISP-86.

The muLISP-86 tutorial is also similar to that furnished with muLISP-83. Topics covered include the relationship between b-trees and lists, defining functions, list manipulation and associated functions, control structures, the use of recursion, and graphics. Purchasers of muLISP-86 also get a three-issue subscription to the *Soft Warehouse Newsletter*.

FEATURES

In contrast to earlier versions, muLISP-86 provides a useful on-line help facility for a large number of muLISP's primitively defined functions. After loading the help file, you simply invoke the help function with a particular function name as the argument, whereupon the system returns the particular function's arguments, type, and the number of the page in the manual that contains a more detailed reference.

The muLISP-86 system provides access to IBM PC hardware via primitive functions that let you read and write directly to absolute memory addresses (memory), execute an interrupt (interrupt), read or write from an 8086/8088 port (portio), and suspend the muLISP system to load and execute another program (execute). The execute function even lets you pass a string of arguments to the other program, expressed as an optional argument to the LISP function. This is extremely useful in artificial intelligence applications, such as speech recognition or image processing, where the muLISP system relies on other programs (possibly written in other languages) to provide some degree of preprocessing.

The muLISP-86 system supports integer and real-number data types. It currently does not support an 8087 coprocessor. The editor (and the entire muLISP-86 development system) appears to work fine with keyboard intercept and memory-resident programs such as SideKick.

SYSTEM REQUIREMENTS

The muLISP-86 system is designed to run on an IBM PC, XT, AT, or PCjr with either a monochrome or graphics display. Soft Warehouse claims that the system also runs on other MS-DOS computers. I was able to run muLISP-86 successfully on an NCR PC4 with a monochrome display and also on an AT&T PC 6300.

The documentation states that you need a minimum of 128K bytes of memory, with at least 256K bytes recommended. Note that muLISP-86 can take advantage of up to 512K bytes of installed memory, which may be a useful feature in large program development.

Finally, you can run muLISP-86 with one disk drive, but the company recommends that you use two drives to avoid swapping disks after loading the system. The compact size of a minimal system, however, makes muLISP-86 suitable for use on the IBM PCjr.

CONCLUSIONS

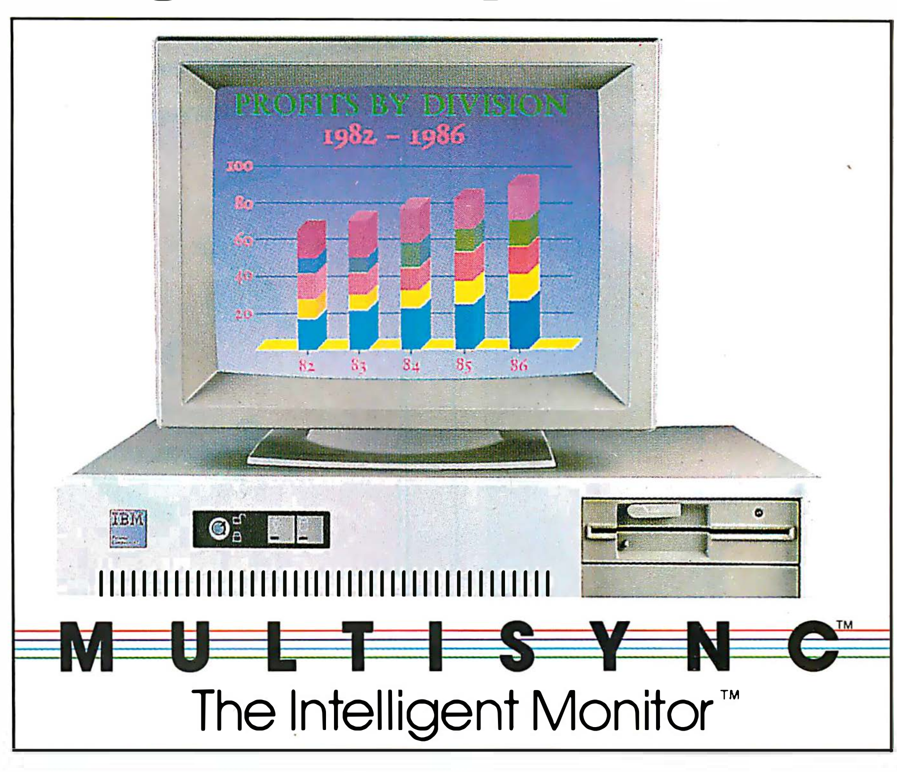
The muLISP-86 system represents some improvement over muLISP-85 and a significant improvement over muLISP-83. Its major strength is its suitability for use within the constraints of the microcomputer environment (i.e., with limited memory and floppy disk space). The system is reasonably user-friendly and might be considered a viable alternative to other LISP development systems for the IBM PC such as Golden Common LISP and the public domain XLISP.

A particularly good use for muLISP-86 would be for educational purposes and situations where absolute Common LISP compatibility is not essential and cost-effective LISP programming capability is desired. While muLISP-86 does not provide all the user-friendliness and functionality of the more comprehensive mainframe and dedicated LISP machine environments, it represents a significant enhancement over muLISP-83. It is well worth a serious look. ■



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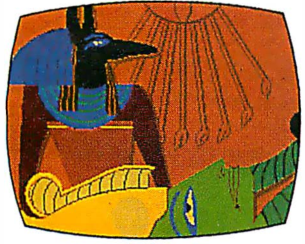


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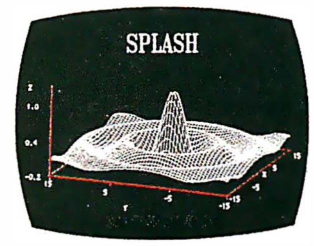
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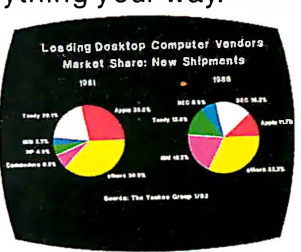
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ITC's Modula-2 Software Development System

BY MARK BRIDGER

An inexpensive Modula-2 compiler and editor package for IBM PCs and compatibles

The Modula-2 language was developed by Professor Niklaus Wirth, who also created Pascal. As a longtime Pascal and Turbo Pascal user, I wanted to compare the two languages and to examine the version of Modula-2 from Interface Technologies Corporation (ITC).

USING THE ITC EDITOR

ITC's Modula-2 has a built-in syntax editor. This sort of editor is probably familiar to you if you've programmed in LISP. In the ITC implementation, each Modula-2 construct has a template that is invoked using an <Alt>/keystroke combination. For example, pressing <Alt> F produces the template

```
FOR <id>: = <expr> TO
   <expr> DO
END;
```

You use the Tab key to skip to the two fields delineated by < > and fill in the missing variables and expressions. Statements between DO and END can be entered by using the <Alt> P command; semicolons are inserted automatically for each statement. If an inserted statement is a template, then the editor automatically indents it appropriately. The editor also adds right-hand parentheses to match the left-hand ones that you type in.

It is impossible to type in a program using the ITC editor without employing these templates. At first this seemed annoyingly cumbersome, but there is a method to it. First, Modula-2 is a case-sensitive language, and all reserved words such as FOR, TO, and END must be capitalized. This can be very annoying, even to a good typist. The use of templates obviates this difficulty. Second, the use of templates virtually eliminates syntax errors and makes it extremely easy to learn Modula-2, especially if you already know Pascal. While it takes some time to get used to the various <Alt> commands to invoke the templates, ITC has made them as mnemonically reasonable as possible (e.g., <Alt> F = "FOR...," <Alt> A = "ARRAY[...]," etc.). The <Alt> commands have different meanings depending on whether you are in the declaration, type, or code section of the program. In the declaration section, for example, <Alt> F gives the template for a function (i.e., a procedure with RETURNed value).

You can also import files of code prepared by other editors. Unfortunately, the ITC editor is finicky about syntax; it will not import any code that has any syntax errors, including errors resulting from incompatibility with various ITC Modula-2 library declarations. If an error is discovered during importation it is pointed out, but it must be corrected using another editor.

The ITC editor provides some of the features found in more standard editors, such as searching for, copying, and replacing strings. The editor also lets you embed blocks of code within other blocks or, inversely, extract marked blocks from within others. The blocks, however, must be full syntactical (indentation level) blocks (e.g., a complete BEGIN...END or REPEAT ...UNTIL block). In general I found the editor a bit unwieldy, since many of its commands are accessed through function and Alt keys that call pull-down menus. These menus in turn require selection of a field (using the Tab key) and then perhaps further keyboard input. For an unskilled typist this is probably all right, but most serious programmers have enough typing skills to make this procedure rather frustrating.

You can use the editor to move around within the program in two ways: line by line with the left and right arrow keys (the working line becomes highlighted), or block by block with the up and down arrow keys. The term "block" here means a syntax block (i.e., a group of lines of code at the same indentation level). You continue to move in blocks of the same level until you reach a larger block size; thereafter, moves are in these larger blocks. Moving down a level is accomplished through the left and right arrow keys. This can permit fairly quick movement through a modest-size program, but not really fast enough through a larger one. The addition of page- or screen-size movement would be useful.

Whether the syntax editor for ITC's Modula-2 is better than a standard text editor depends on your familiarity with the package and personal preference. I didn't like the ITC editor

(continued)

Mark Bridger (31 Champa St., Newton, MA 02164) is president of Bridge Software and an associate professor of mathematics at Northeastern University.

Modula-2 Software Development System

Type
Modula-2 compiler and development environment for MS-DOS and PC-DOS

Company
Interface Technologies Corporation
3336 Richmond
Suite 200
Houston, TX 77098
(713) 523-8422

Requirements
IBM PC or compatible; 256K bytes of RAM; two floppy disk drives

Features
A built-in syntax-directed editor checks the code as it is written

Price
Modula-2 Software Development System (standard package): $80.88
Modula-2 SDS-XP (with additional utilities): $99

at first, but after using it I began to appreciate its templates.

COMPILING AND LINKING

The entire ITC Modula-2 package of editor, compiler, and linker is all in one unit. Choices are made by means of pull-down menus, and execution is done by overlaid code. Running ITC's Modula-2 from a floppy disk drive is a slow process. I ran it from a RAM disk, but this requires over 600K bytes of RAM. Early versions of the program had serious bugs when run on RAM disks, although I have not had any system freeze-ups while compiling with the latest version (version 2).

ITC's Modula-2 seems to conform to the standards set forth by Wirth for Modula-2. All standard libraries are available as well as some additional ones; for example, there is RealInOut, a library for reading and writing real numbers. RealInOut, however, has two annoying features: It only outputs real numbers in scientific notation, and if a real number is entered from the keyboard without a digit in front of the decimal point, the real number is recorded internally as 0 without any warning. In addition, the field width parameter still has a bug that was present in earlier versions.

ITC implements the Modula-2 open array parameter, which allows a procedure declaration to accept an array of a specified type but a nonspecified length. The bounds are determined when the procedure has accepted a particular array at run time. This is a very useful improvement over Pascal, especially for writing library procedures for, say, matrix manipulation.

There is also a graphics interface that supports point, line, and box drawing (all of which are quite slow), a sound interface enabling the production of a tone of prescribed frequency, a DOS interface, and a procedure to perform certain DOS and BIOS interrupts. For about $20 more, ITC offers a Foreign Object Module Import package, which is essentially a tool for linking ITC Modula-2 with 8086 assembly language object modules. This package has some restrictions, the most serious being its apparent inability to deal with a separate data segment in the assembly code. This restriction is shared with Turbo Pascal, but Borland International doesn't charge anything extra for the ability to graft on machine code. There are ways around this limitation, for example, putting data in the code segment and jumping over it. Nevertheless, it's an annoying restriction for a large program development system.

ITC's Modula-2 has a built-in library creation facility, enabling programmers to build up collections of separately compiled modules for linking with other programs. Source and object code stored in such a library can be accessed only by opening the library from the editor or the compiler. A bug occasionally prevented the compiler from finding one of my libraries when it was in drive C. The compiler could only find the library when it was on the floppy disk in drive A.

The ITC editor and compiler appear to interact, with the compiler doing some preliminary work as code is entered into the editor. I could not determine exactly what this work entailed; a menu choice offers the option of turning this background compilation off, but it didn't help when I tried to import a syntactically incorrect file.

It is important to remember that Turbo Pascal is limited to compiled code of fewer than 64K bytes. There is no such limitation for ITC Modula-2: Programs can be as long as the disk or the memory can handle.

BENCHMARK RESULTS

For this review, I rewrote the benchmarks from my review of Turbo Pascal 3.0 (see February BYTE) in Modula-2. As shown in table 1, Turbo Pascal has the edge in all categories except arithmetic floating-point operations (multiplication and division) done with the 8087, where ITC has a three-to-one speed advantage. On the other hand, Turbo Pascal has an equally dramatic advantage in non-8087 number crunching and in heap management.

In analyzing compilation speed, however, one must be fair. Modula-2's task here is somewhat harder since it is producing code that will later be linked to other code. This is a more complicated procedure that takes longer to complete. ITC's Modula-2 produces .EXE files, while Turbo Pascal produces .COM files. In general, the executable files produced for the benchmark programs by ITC's Modula-2 were from 2 to 2½ times larger than those produced by Turbo Pascal.

DOCUMENTATION

ITC's Modula-2 documentation comes in a loose-leaf binder. It provides a better introduction to the basics of the language than does Borland's Turbo Pascal documentation. If you already know Pascal, you probably can get by with ITC's documentation; if you haven't programmed in Pascal, you should get a good book on Modula-2 as an introduction.

Since all procedures, constants, and variables in Modula-2 that are imported from libraries must be declared in an importation section, it is essential to know which identifiers go with which standard libraries. This is difficult to determine from the documentation; the index is not always helpful since there are some page

(continued)

number discrepancies. Even more serious is the fact that different libraries can have the same identifier with the same spelling in two different contexts. For example, Done is Boolean in the InOut library but part of an enumerated type in the Files library. A complete cross-referencing table of the libraries and their contents would have been very helpful.

It would also have been useful to have the description of function-key use in a more prominent position near the front of the manual.

Overall, ITC's Modula-2 documentation suffers from a lack of all but the simplest examples. While the beginning tutorial covers elementary Modula-2 constructs, program writing, and compilation, more complicated areas such as the building of independently compiled libraries and the use of in-line machine code and BIOS interrupts could use some further explanation and illustration.

BUGS

The first version of ITC Modula-2 that I examined seemed to have more bugs than any other piece of serious software I've used. Most of these bugs seem to have been corrected in the most recent release.

The compiler occasionally gives misleading error messages. In one case when I had invoked the NEW procedure to create a pointer, I was told that the variable had not been declared; however, it had been. What I hadn't done was to import the ALLOCATE and DEALLOCATE procedures from the system library. Even though no explicit calls to these procedures were made, they are necessary for the functioning of NEW and DISPOSE. This took quite a few minutes for me to figure out

ITC operates a bulletin board on which fixes for various bugs are posted. This is fine if you live within a local call of Houston, Texas, but swatting all bugs by long-distance phone lines can get to be quite expensive.

TURBO PASCAL VS. MODULA-2

There are some real philosophical, psychological, and practical issues here. The philosophy and psychology have more to do with Pascal versus Modula-2 than with any particular brands of compilers.

If you believe that Pascal is an overly formal language that stifles creativity but that it is useful for building "pyramids"— large, complicated programs built up from many modules—then you will find Modula-2 much the same. In Pascal there is only one really dynamic, flexible, and standard procedure: the lowly WriteLn. The WriteLn command, which allows a variable number of parameters of different types, has been eliminated in Modula-2 and replaced by WriteChar, WriteString, WriteInt, WriteCard, and WriteReal. These must actually be declared with correct capitalization, and their library genealogy must be traced out. If you're going to be subjected to these indignities, you might as well program in C and at least be able to produce tighter code. If you hate Pascal, you'll find Modula-2 worse.

On the other hand, you can make the argument that this sort of care and attention to detail is necessary when dozens, or hundreds, of programmers are working on a project involving tens of thousands of lines of code—code that must be modular and portable.

Therefore, you must determine your own needs and how much you enjoy programming. If you are writing programs that are no longer than 3000 to 4000 lines, then there doesn't seem to be any reason for not using Turbo Pascal. It's faster, tighter, more flexible, smaller, simpler, and less expensive than anything else currently on the market.

On the other hand, if you must work with many other programmers on a huge program or if you need training for such work, then you probably should try Modula-2. Whether or not Modula-2 will ever gain much popularity as a commercial language, the ITC syntax editor can make learning it easier. Furthermore, ITC has provided a lot of value for the money, with a basic package that includes the assembly language interface, extra libraries, and a Make utility. It's worth a try, but don't throw away your Turbo Pascal. ■

Table 1: *Benchmark comparisons. The* CALC *program shows how long it takes to do* 10,000 *multiplication and* 10,000 *division operations using single-precision numbers. The* FLOAT *program tests* ITC *Modula-2's library of transcendental functions. The* SIEVE *program shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The* TRANS *program shows how long it takes to copy a* 10,000*-character file one character at a time, while* BTRANS *shows how long it takes to copy this file* 128 *bytes at a time. The* LINETEST *routine was run with Turbo Pascal's standard draw routine and with Modula-2's draw routine.* HEAPTEST *performs a rough check to see if the creation and disposal of dynamic variables is working properly. All times are in seconds.*

Program	ITC Modula-2	Turbo Pascal
CALC	52	32
CALC87	2	6.5
FLOAT	212	65
FLOAT87	5	3
SIEVE	19	13
TRANS (disk to disk)	129	124
TRANS (RAM to RAM)	98	93
BTRANS (disk to disk)	23	22
BTRANS (RAM to RAM)	2	1.5
LINETEST	31	17
HEAPTEST	12	< 0.5

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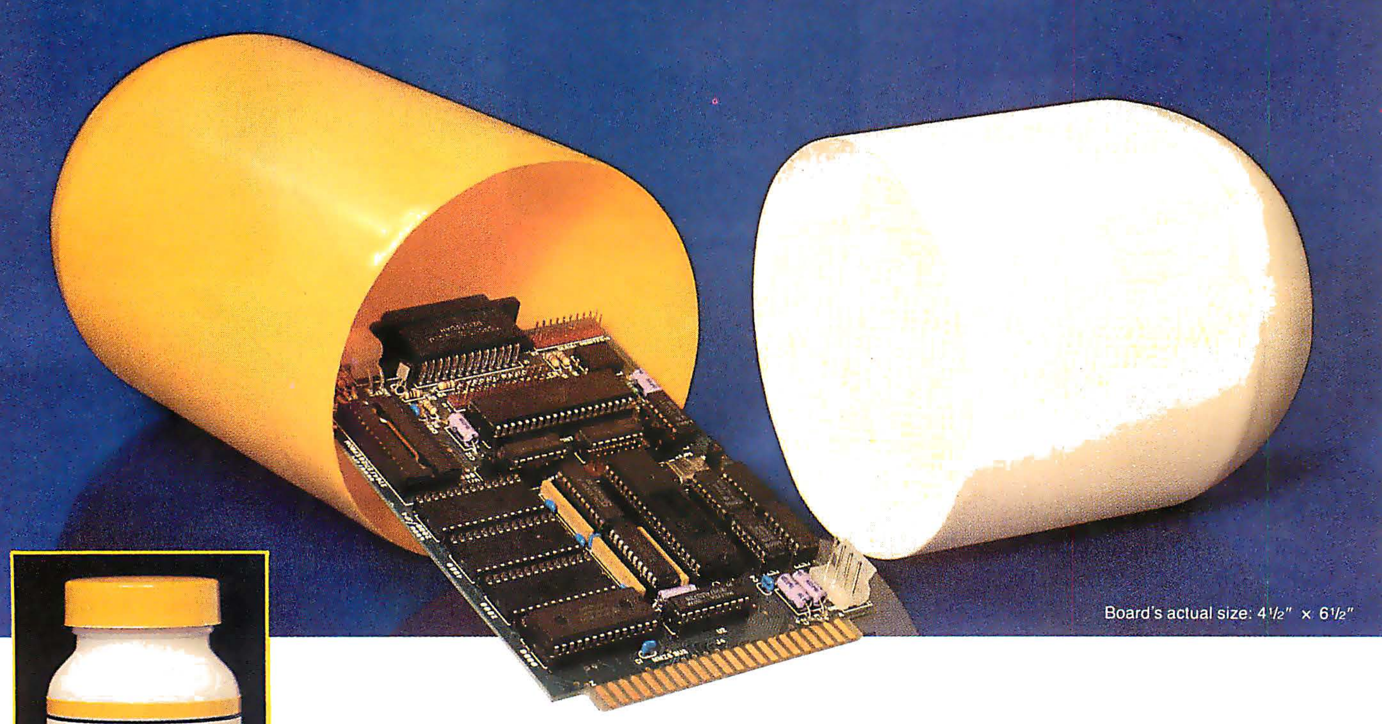
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MICROSOFT WORD VERSION 3.0

BY MALCOLM C. RUBEL

A word processor with many powerful features and some flaws

Microsoft Word version 3.0 for MS-DOS systems, with its several new and versatile features, is one of the most powerful word-processing programs on the market today, but I wish I could be more excited about it. Word is full-featured, but it lacks the comfort and speed I have come to expect from top-of-the-line programs. It also has several annoying defects.

INSTALLING WORD

Microsoft has dropped copy protection from its product line. Therefore, you can now make any backup copies that you need.

The installation process is virtually foolproof. Both floppy disk and hard disk installations with or without the mouse driver are no problem, but when you install Word on a floppy disk you do not have enough space left for DOS. To get a bootable disk, you must first delete the Help files.

LEARNING WORD 3.0

Microsoft's Learning Microsoft Word program is the best interactive tutorial that I have seen. It is well thought out and provides an excellent course of instruction, good feedback, and a good simulation of the actual program operation.

You can now access tutorial lessons while editing a document using Word's Help function. This requires that 256K bytes of available RAM must be installed, but you get quick access to detailed information about basic operations. Context-sensitive Quick Help is also available within the program. If all else fails, you can go to the improved index, which is now 43 pages long.

Microsoft took one step in the wrong direction with this latest release. The plastic command template of version 2.0 has been replaced by a small function-key overlay that flies off when you hit a key slightly off-center and a Quick Reference Card that always seems to be somewhere else and, when found, occupies significant desk space.

The operator interface is excellent for beginners. With only a few minutes of familiarization, the commands become self-evident. A novice can quickly gain access to the whole range of the program's powers. The problem is that this ease of use for beginners compromises fluid operation. Although there are speed keys available for some commands, I was continually going through menus making many unnecessary moves to implement simple commands.

OPERATION

Although Word 3.0 works on a floppy disk system, it would operate more smoothly on a hard disk system. To use Word you need the program disk, the spelling disk, the Learning Microsoft Word disk (for reference), and, if you want to run any external commands, a DOS disk to run the program. I was switching disks too often for my liking. Using Word on a floppy disk system is also slow (see table 1 for complete benchmark results). While Word runs mostly from RAM, the active document files are run on a very tight paging scheme. Information is constantly being written to and from disk. Increasing memory size does not seem to do anything to alleviate this problem.

While editing with Word is easy, Microsoft should do some work to make the editor faster. Using the mouse to move the cursor is almost a necessity because Microsoft has not included any Control-key commands to move the cursor. While you can get by with using the text-definition function keys to move the cursor, it would not be too much trouble to implement some of the now generally accepted Control-key cursor commands.

Word 3.0's PgUp and PgDn screen rewrites are some of the slowest I have seen. Depending on whether or not you have to go to the disk for information, it can take from 1.5 to 5 seconds (a 3.5- to 4-second average) to get a new screen of text. I also had a serious problem with the Delete key. All deletes are written to a scrap buffer, which takes quite a bit of time. When you strike the Delete key twice without consciously hesitating between the two hits, one keystroke is lost.

Search and replace operations have the necessary options and work well, but they are slower than those of many comparable programs. I also ran into memory problems when performing the Replacement benchmark.

(continued)

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Microsoft Word version 3.0

Type
Word processor

Company
Microsoft Corporation
10700 Northup Way
P.O. Box 97200
Bellevue, WA 98009
(800) 426-9400

Format
5¼-inch floppy disks

Computer
IBM PC compatibles

Necessary Hardware
Mouse (optional)

Necessary Software
MS-DOS

Features
Includes an integrated outliner, math functions, and index and table of contents generation

Documentation
Using Microsoft Word
Reference to Microsoft Word
Printer booklet

Price
$450

The program stopped and required that my current work was first saved to free up the memory before continuing. The manual states that this might also happen when several windows are open. Going to 512K bytes of memory did not help this situation.

When you work with justified text, Word becomes annoying. In an attempt to make the on-screen text look just as it will look when printed, Microsoft right-justifies text on the screen. This means extra work for the processor, and it slows down screen reformat time. It also means that text continuously bounces to the left and to the right of the cursor position. I decided to work with unjustified text and, as a final step, to justify it.

Because the cursor is a solid unblinking box, I found that I kept "losing" it. Microsoft should give the user the option to make it blink and should at least provide line and cursor position numbers somewhere on the screen.

Block operations with Word 3.0 are well designed and easy to execute. Text is defined by using either the mouse or the cursor and the function keys. It is then deleted to scrap using the Delete key and then "undeleted" from scrap using the Insert key at the appropriate place either within the file, between windows, or to disk. Column-block operations are now supported, and those who work with tabular data will be thankful for this addition.

Microsoft makes better use of windows than any other word-processing program on the market. Not only can you have up to eight different windows on the screen at the same time showing you different files, but you can also have multiple windows open within a single document. Other programs allow different copies of the same file to appear in different windows, but changes made in one window are not automatically made in the others as they are with Word. You may pay a speed penalty as you open up more windows, but it is worth every second.

Table 1: *Benchmark test results in seconds. All benchmarks were performed using* MS-DOS 3.1.

	Word 3.0	WordStar 3.3	WordPerfect 4.1
Load program	24.3	9.5	12.8
Load 4000-word file	5.7	4.2	4.2
Save 4000-word file	30.0	26.7	15.6
Cursor through file	90.1	48.6	75.7
4000-word search	18.2	12.5	8.7
400 replacements	85.7	25.3	12.8

Boilerplate materials can be easily prepared and called to an active file using Word's Gallery function. However, I found that it was so easy to open up a second window and copy text into it that I chose not to use this function.

FORMATTING

Word 3.0's greatest strength is its ability to perform complicated formatting tasks. It is not a page composition or desktop publishing program, but it handles complicated formats such as tabular materials, snaking multicolumn and screenplay layouts, and different type styles and point sizes with ease. Detailed formats can be described for character size and attributes, paragraph style, division (page) layout, tabs, footnotes, headers, and footers. Any defined style can be saved and recalled for later use with different documents.

Word allows you to specify all page measurements in inches, centimeters, or points. The program handles most of the complicated formatting tasks for you. For example, if you wish to have multiple columns, you simply specify the number of columns desired and the space between each of them, and the program does the rest. Setting up and working with tables is equally simple.

As with other top-end products, Word 3.0 supports multiple left- and right-facing headers and footers, several tab types, and also centered and flush-right text.

Character specification is limited only by your output device. If you are using a laser printer with downloadable fonts, you will be able to produce impressive output. Word is the only word-processing program for the IBM PC that supports Apple's LaserWriter printer and PostScript program.

Page formatting does not always show up properly on the screen. Word cannot handle proper on-screen line breaks when you use proportional spacing. In addition, neither snaking nor side-by-side columns are shown on-screen.

Word does not do a good job with right justification. It inserts microspaces only between words. If it placed microspaces between charac-

ters within words as well as between words, the output would look better.

PRINTING

Printer support, always a strong point with Word, has been improved. There are 113 different printer choices, or you can go to the printer booklet to find out how to make your own driver. Word 3.0 also supports sheet feeders and printer queuing.

Although pagination is performed automatically when you print and includes widow and orphan control, you still have to repaginate a document if you want to see where the page breaks are going to be before you print. You can now select confirmation of page breaks and make modifications if you desire, but Microsoft could make a substantial improvement in Word by adding dynamic pagination.

One of the best improvements in version 3.0 is that text no longer needs to be enhanced by only the user's knowledge of the output device's capabilities. The program will make a guess at the formatting equivalent for the output device selected. For instance, italics specified for the final work will probably come out as underlined text on a printer that cannot print italics.

Word prints with a gutter margin that selectively offsets left- and right-facing pages. If you are going to do two-sided printing and binding, this feature is important. One flaw that I discovered in the program is that when I set equal margins of 1¼ inches for the left and right side of the page and printed on an HP LaserJet, Word gave me a 1½-inch left margin and a 1-inch right margin. While this can be easily compensated for, it presents an unnecessary complication.

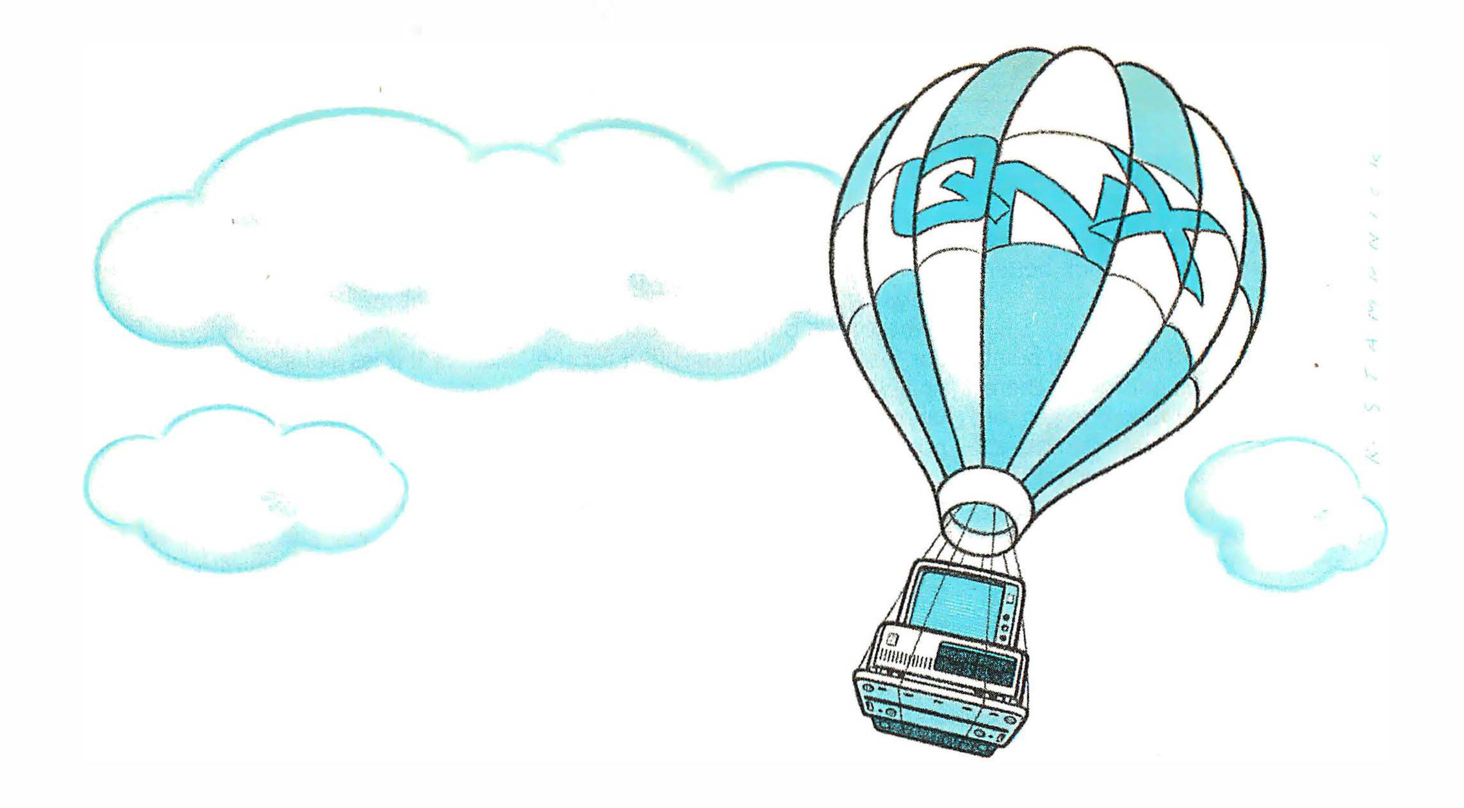
THE POWER OF WORD 3.0

Word 3.0 does footnotes and has an option for endnotes. It also has its own Spell program. Word does math functions and multilevel indexing and table of contents generation. It has an excellent mail-merge routine that includes conditional printing for form letters. It does alphabetic and numeric sorts and it hyphenates. It contains an excellent outliner and, hidden in the appendix, instructions for some of the most complete data conversion programs I have seen.

The features I would like to see added include a faster editor, line and box drawing, and the ability to capture command macros.

SUMMARY

I am not a fan of Microsoft Word partly because I do not like menu-driven programs. They get in the way during the writing process. Part of the attractiveness of Word 3.0 is that it is powerful yet easy to learn. However, after you become familiar with the program, its menus, which are so easy to understand and use while learning, become a hindrance. ■



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THE NORTON UTILITIES, PC TOOLS, AND SUPER UTILITY

BY RUBIN RABINOVITZ

Three useful programs for file and data restoration and file management

Sooner or later most computer users lose data because of equipment malfunctions or human error. The DOS programs for personal computers typically contain few ways of coping with such problems; hence, specialized programs with recovery routines have become popular.

The best-known program of this type is The Norton Utilities, designed for the IBM PC and most compatibles. Created by Peter Norton, the program is now in its 3.1 release, a version coauthored by Norton and Brad Kingsbury. In my review of The Norton Utilities version 3.0 (December 1985 BYTE), I described it as a valuable program, one that I had used many times for recovering lost data. Here I will discuss what is new in version 3.1 and compare it to two of its rivals: PC Tools (version 1.10) by Central Point Software and Super Utility (version 1.10) by PowerSoft Products (see tables 1, 2, and 3 for feature comparisons).

RESTORING ERASED AND DAMAGED FILES

The ability of programs like The Norton Utilities, PC Tools, and Super Utility to restore lost data depends in part on the kind of error that is involved. A common error (and one that is relatively easy to correct) is the one that occurs when you mistakenly enter a DOS ERASE or DEL command and inadvertently lose a valuable file. If no new information is subsequently written to the disk, the deleted file can in most cases be restored in its entirety by any of these utility programs.

Recovery from such errors is possible because the DOS program does not remove any data at the time you give the ERASE command. Instead, messages indicating that the sectors occupied by the original file can be used for new data are registered in the disk's directory and file allocation table.

Unfortunately, most data-loss errors are not this simple. Once new information has been written into the sectors formerly occupied by a deleted file, the old information can no longer be recovered. It also becomes harder to recover portions of the deleted file that haven't been overwritten. (Reclaiming part of a lost file may be worthwhile in the case of textual information, but program, spreadsheet, and other structured files often have to be recovered virtually intact if anything of value is to be extracted from them.)

When a computer hardware problem, such as a misaligned disk drive, causes incorrect control information to be written into a file, successful data recovery is more problematic. Errors in a directory or file allocation table may render all of your files inaccessible. Your only hope then may be to work directly with the physical sectors on the disk using a utility program's sector read/write routine. This method will usually require you to piece together your original file from sectors that are scattered all over the disk.

If you decide to patch a disk in this manner, you should know that a little exploratory tinkering can transform a small local problem into a major disaster area. Unless you have no alternative, do not work with original files and disks. If possible, make a copy of the disk with a damaged file.

FILE RECOVERY FEATURES

The Norton Utilities, PC Tools, and Super Utility all let you display directory listings of recently deleted files, as well as listings of those that are active. If a directory entry for a deleted file has been erased, the programs will let you search through the entire disk (including deleted files) for a string of text, provided you can remember some of the lost file's contents. If not, you can go from sector to sector on the disk to see if you can find any data from the lost file.

Once you have located a sector with lost data, you can read it in hexadecimal or ASCII formats or put the information in another file (preferably on another disk). Working with the sector display, you can even edit the data in a given sector. Experienced users can take advantage of this function to make certain types of repairs, such as locating and revising any incorrect control information in a file.

REPAIRING FILES WITH THE NORTON UTILITIES

The Norton Utilities' file restoration program has a branching menu struc-

(continued)

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	The Norton Utilities (version 3.1)	PC Tools (version 1.10)	Super Utility (version 1.10)
Type	File recovery, disk management, and data-security utilities	File recovery, disk management, and resident DOS utilities	File recovery and disk management utilities
Company	Peter Norton Computing 2210 Wilshire Blvd. Santa Monica, CA 90403 (213) 453-2361	Central Point Software 9700 Southwest Capitol Hwy. Portland, OR 97219 (503) 244-2782	PowerSoft Products 17060 Dallas Parkway, Suite 114 Dallas, TX 75248 (214) 733-4475
Format	One 5¼-inch floppy disk	One 5¼-inch floppy disk	One 5¼-inch floppy disk
Computer	IBM PC, XT, AT, and most compatibles	IBM PC, XT, AT, and most compatibles	IBM PC, XT, AT, and most compatibles
Necessary Software	PC-DOS or MS-DOS 2.0 or later	PC-DOS or MS-DOS 2.0 or later; can repair disks formatted under DOS 1.0 or later	PC-DOS or MS-DOS
Documentation	64-page manual; quick-reference card; some on-screen help	68-page manual; some on-screen help	31-page manual; some on-screen help
Price	$99.95; upgrade from an older version, $25	$39.95; upgrade from an older version, $15	$89.95

Table 1: *File restoration utilities.*

Function and Explanation	The Norton Utilities	PC Tools	Super Utility
Undelete: reverses the DOS DEL command	x	x	x
File repair: restores damaged files, sector by sector	x	x	x
Lost cluster saving: copies stray clusters into usable files	x	x	x
Quick file repair: automatically "undeletes" files	x	—	—
Disk mapping: displays a graph showing used and free sectors	x	x	x
Bad sector mapping: displays a graph with locations of bad sectors	x	x	—
Disk test: checks disks for errors	x	x	x
FAT contents: gives decimal listings for items in the file allocation table	—	—	x
Disk viewing: displays contents of a disk's sectors in hexadecimal and ASCII	x	x	x
Data modification: permits entering data directly onto the disk in ASCII or hexadecimal format	x	x	x
Sector printing: prints contents of sectors, including sectors from damaged files	x	x	x
Data search: performs a global search for a predefined string of characters; search string can be defined in hexadecimal or ASCII	x	x	x

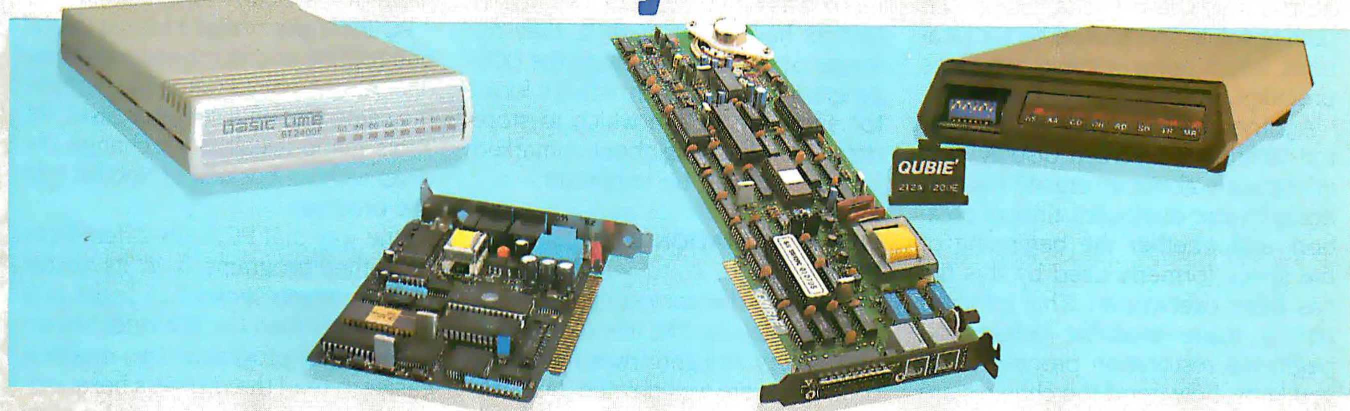
ture that may be somewhat confusing until you have used it for a while. This is partly because the program contains so many routines that it can be hard to find your way through the menus and submenus to the one you need.

A feature called quick unerase, which has been added to the latest version of The Norton Utilities, compensates for this problem to some degree. Quick unerase will be a boon to novices; it makes the process of restoring deleted files almost automatic. Even so, this routine works only for the simplest types of file recovery; for others you will still need to use the conventional file restoration program. But here you will be aided by another recent Norton addition: The program now has some on-screen help information about the procedures you need to follow. Thus, if you are working with a file allocation table, you can easily summon up a help screen with information about it.

In addition, The Norton Utilities lists information that experienced users will appreciate. It gives a number representing the absolute disk location of a displayed sector. In PC Tools and Super Utility, a similar listing gives only the relative locations for sectors (i.e., their positions within a file). I prefer the first approach; the absolute location is useful when you want to return to a particular sector or if you are working with stray clusters (blocks of data that have become detached

(continued)

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from a file). Of course, a listing with both absolute and relative sector locations, which none of these programs provides, would be even better.

Another useful feature of The Norton Utilities is a screen display with information about an erased file that notes its size, attributes, time of creation, and whether the beginning of the space formerly used by this file has been overwritten. This information is made available before you begin the restoration process to let you know how good the chances are for recovering a lost file.

Of the three programs, The Norton Utilities gives the most comprehensive information about bad sectors (unusable areas of a disk). Not only do you learn whether they are present on a particular disk, but the program also lets you know if they have been marked as bad sectors. Once the bad sectors have been marked, they no longer pose a threat because the DOS program will avoid them when it looks for empty sectors in which to store data. Thus, knowing about unmarked bad sectors can be important.

File Restoration with PC Tools

PC Tools is the easiest of the three programs to use. The menu organization is very straightforward, and the commands are well defined. Like The Norton Utilities, it provides good disk maps, which are graphic representations of the disk showing the locations of files and unused areas of the disk. The on-screen help information in PC Tools, while not as extensive as that provided by The Norton Utilities, makes the steps in the file restoration procedures clear.

PC Tools also makes it simple to end one routine and to move on to a new one. At one point I wanted to perform the same test on a series of disks. PC Tools made it easy to exchange the disks without backing up too far into the program.

One way that PC Tools differs from the other programs is in its sector display, which shows 256 bytes at a time rather than the 512 bytes shown in the other programs. This makes it easier to read the display's hexadecimal information, but it can also slow down some operations because you have to examine twice as many screens when you look through the contents of a given file.

Data Restoration with Super Utility

While Super Utility works well for restoring lost data, it lacks certain features found in The Norton Utilities and PC Tools. Super Utility has no provision for identifying the position of a particular byte in the sector display. Its disk map is not very good; the graphics are crude, the locations of files and unused sectors are not shown, and the map does not display information about a disk's bad sectors. However, like the other programs, Super Utility does contain a separate routine that tests a disk for bad sectors, so it is possible to use this program to get that information.

On the positive side, Super Utility contains two file repair features that the other programs lack. One is a very useful window display that lets you look at the contents of a sector before deciding whether to add it to a file that is in the process of being restored. The second feature is a routine that provides listings in decimal format of the entries in a file allocation table—a tool that advanced users will probably find valuable.

Supplementary Features in The Norton Utilities

One unique operation in The Norton Utilities is a program for systematically overwriting any resident data in an unneeded file to make sure it is entirely erased. This feature—the computer equivalent of a paper shred-

Table 2: *Disk and file-handling utilities.*

Function and Explanation	The Norton Utilities	PC Tools	Super Utility
File-handling utilities			
File attributes: changes archive, read-only, hidden, and system attributes	x	x	x
File size: gives file size as a number of clusters, as well as in bytes	x	x	—
File overwrite: writes zeros into deleted files for security purposes	x	—	—
Directory-handling utilities			
Directory sort: permits directory to be sorted by name, size, extension, and date	x	x	—
Directory restore: recovers deleted directories and subdirectories	x	x	—
Create subdirectory: creates new subdirectories without exiting to DOS	—	x	—
Disk-handling utilities			
Title change: permits changing the volume label of a formatted disk	x	x	—
Disk overwrite: overwrites zeros onto an entire disk for security purposes	x	—	—
Hard disk utilities			
File search: searches through directories and subdirectories for a specified file	x	x	—
Path-name list: lists path names for files in directories and subdirectories	x	—	—
Tree display: provides a chart of directories and subdirectories, showing the tree structure	—	x	—
Hard disk configuration: permits partitioning of hard disks, according to user's specifications	—	—	x

der—will be valuable if you work with confidential data. The Norton program also includes a routine for setting screen colors, a test for comparing the processing speed of your computer with that of an IBM PC, and a timer that lets you know how long a program has been running. The timer performs the same functions as a stopwatch.

The Norton Utilities version 3.1 has a number of interesting new features. One is an easier way of working with the program's menus. You can choose a command by moving a pointer to an item on the menu, by pressing a number (such as 3 for the third menu item), or by pressing the equivalent function key (in this case, the F3 key). This duplication reduces the possibility of key selection errors and simplifies the entering of commands. Another nice feature is a demonstration file that lets you see how the main features work. It provides a good introduction to the program and its diverse routines.

The Norton Utilities version 3.1 also lets you restore directories that have been removed by the DOS RMDIR or RD commands. Also added is an option for working with European characters. Still another change is in the routine for sounding a tone: You can now specify the duration, pitch, and number of times it should be repeated.

Supplementary Features in PC Tools

The most valuable extra feature of PC Tools is its ability to be loaded in a resident mode. Like SideKick and other resident programs, PC Tools remains in the computer's memory while you run an applications program such as a spreadsheet or word processor. Whenever you wish, you can interrupt the applications program, work with PC Tools, and then pick up where you left off in the applications program.

PC Tools contains a series of routines for performing familiar DOS tasks such as copying, comparing, and formatting disks. These features are part of the resident program, which leads to some interesting possibilities;

(continued)

for example, you can format a disk without formally exiting from the word-processing program. (A list of the DOS utilities included in PC Tools is given in table 3.)

If you are unfamiliar with memory-resident programs, you should know about two potential problems. One is that your seemingly docile applications program may object to the idea of coexisting with a memory-resident program. Whether or not your applications program can run concurrently with PC Tools is something to check with the dealer or the manufacturer.

The other factor is that PC Tools takes up 128K bytes of RAM, and unless you are willing to buy a memory-expansion board, it may be too large for you to use with another program. The authors of the program are planning to deal with this problem in a future release; PC Tools will be compressed to between 40K and 64K bytes so it will take up less space in RAM.

A unique feature of the program is a tree display that diagrams the root directory and the other directories on a disk. Another helpful feature of PC Tools is that supplementary information about a routine is automatically displayed when you tab to the menu entry offering that option.

Hard Disk Configuring in Super Utility

Like The Norton Utilities and PC Tools, Super Utility has a feature for changing a file's attributes, such as making it a hidden or read-only file. Super Utility's main supplementary feature is a routine for the custom configuration of hard disks. With most hard disks, you are offered limited options for partitioning. Super Utility offers a wider choice of partitioning options, which can make for more efficient data storage. However, this routine must be used with caution because (like the DOS FORMAT command) it involves a process that will destroy the existing data on a disk.

Table 3: *Other utilities and features.*

Function and Explanation	The Norton Utilities	PC Tools	Super Utility
Miscellaneous features			
Screen attributes: sets colors, reverse video, underlining, bold, blinking, etc.	x	—	—
System attributes: identifies computer, lists disk drives, gives RAM memory size, etc.	x	x	—
Speed test: measures operating speed of system relative to the IBM PC	x	—	—
Tone: sounds a tone as a signal during some phase of a computer routine	x	—	—
Print: prints files	x	x	—
Line number print: prints text with line numbers added	x	—	—
Timer: emulates a stopwatch; times various operations	x	—	—
Resident DOS utilities			
Copy: copies files; similar to the DOS COPY command	—	x	—
Copy disk: copies from disk to disk; similar to the DOS DISKCOPY command	—	x	—
Compare: compares files or disks; similar to the DOS DISKCOMP command	—	x	—
Rename: renames files; similar to the DOS REN command	—	x	—
Delete: deletes files; similar to the DOS DEL and ERASE commands	—	x	—
Format: formats disks; similar to the DOS FORMAT command	—	x	—

Documentation

The documentation for all three programs is adequate but not outstanding. The Super Utility manual contains so many undefined technical terms that first-time users will be intimidated, and its skimpy glossary does not make up for this flaw. The manuals for the other two programs use somewhat simpler language, but they also seem to be directed toward users who already have a good understanding of how the DOS program stores files on a disk.

All three manuals provide only cursory explanations of how the data-recovery process works. Given that novices can lose files, a little more background material would help. A chapter for beginners with some illustrations (such as a diagram showing how a disk is divided into tracks and sectors) would have been useful.

All three manuals would be improved if charts were included showing in which branches of the menus the program's different routines are located. This would make it easier to go from one routine to another. The Norton Utilities version 3.1 takes a step toward meeting this need by including a reference card that lists all the program's command names and functions.

Conclusion

The most valuable of these three programs is The Norton Utilities. It offers the greatest number of features for file recovery, as well as the widest variety of supplementary routines. PC Tools is somewhat easier to use than the other two programs, and, at less than half their price, is clearly the best value. Super Utility is a reasonably good program, but its relatively high price and lack of extra features will probably deter potential buyers.

As tables 1, 2, and 3 indicate, The Norton Utilities, PC Tools, and Super Utility differ mainly in terms of the extra features they provide. If you are uncertain about which of the three to get, your sense of whether you will be able to use these extra features should help you make up your mind. ■

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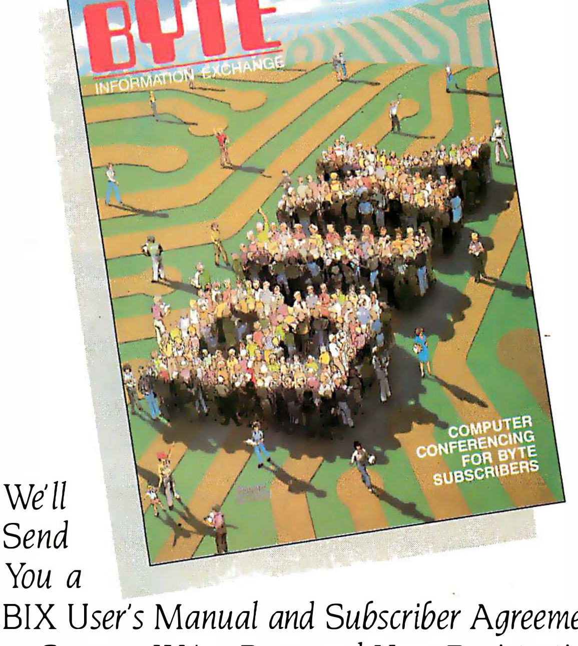
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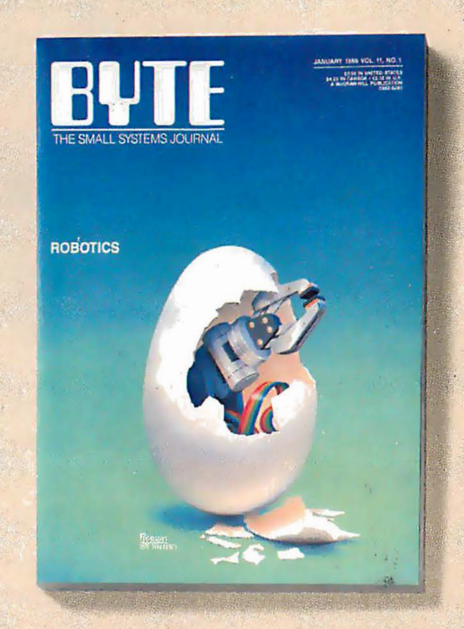
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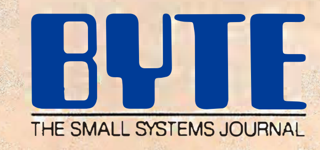
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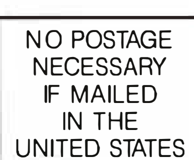
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COMMODORE 128

I read with interest the review of the Commodore 128 by William Wiese Jr. (July). This review was interesting but failed to point out a fatal flaw in the CP/M Plus operating system. The very first CP/M Plus program I ran on my Commodore 128, SD-88, did not print properly. Upon further investigation, I discovered that 10 of the 96 characters in the CP/M Plus printing character set were incorrect. I suspect that some of the nonprinting characters are also incorrect, but I have not investigated them in detail. This flaw is probably in all the Commodore 128s on the market.

Specifically, when running under CP/M version 3.0 (the December 1985 update), 10 characters are not sent to the printer correctly as standard ASCII characters, although they are being sent to the video screen and to the disk properly. For instance, the Commodore 128 CP/M Plus cannot print this simple statement:

"Is that a quotation mark ("), backslash (\ ), caret (^), underscore (__), grave accent (`), left brace ({), vertical bar (|), right brace (}), or a tilde (~)?" John asked.

The reason is that these characters are either missing from or in the wrong locations in the Commodore 128 CP/M Plus printing character set.

I verified this problem at a local store using a Commodore 128 printing to a small single-sheet Okidata thermal printer and again at another store using a Commodore 128 printing to a Commodore MPS-1000 printer.

I recorded the ASCII character set using the Commodore 128 in CP/M Plus mode running Microsoft MBASIC to a disk that had been formatted on an Osborne Executive computer. I then ran the disk on an Osborne Executive and printed the character set to an Okidata printer. In this case, the standard ASCII characters were printed out correctly, proving that recording to disk on the Commodore 128 in CP/M Plus mode works properly.

It appears that the Commodore 128 CP/M Plus writes the correct ASCII character set to the video screen and to the disk system. However, the inability to write the standard ASCII character set to a printer is a fatal blow to the CP/M Plus mode, which is an advertised feature of the Commodore 128. Programs that run and print on other CP/M machines will not run properly on the Commodore 128.

CORTES L. PERRY
Huntsville, AL

Editor's note: Gregg Berlin at Commodore says that you need to tell CP/M in a CONF file to send ASCII to the printer as ASCII, not PETSCII, and to put the printer into IBM mode so that it will expect ASCII.

TOPSI 2.0

In regard to Leonard Moskowitz's review of TOPSI 2.0 (August), a number of facts need correction and update. The price of version 2.1 is $250, and there are two other versions currently available that implement the same OPS5 inference system. Version 1.2, which sells for $125, handles smaller rules but not file I/O. However, this version is excellent for teaching or introductory expert-system development. The latest release, version 3.0, sells for $375 and includes a built-in smart editor, menus, and windows.

Since all TOPSI versions are now in C, we at Dynamic Master Systems Inc. no longer offer the source code for the development of external procedures. However, we will negotiate the licensing of our source code for porting to other computer environments.

DAVID SMITH
Atlanta, GA

DESMET C

In the "DeSmet C Development Package for the Macintosh" (August), Jonathan Robie makes a statement concerning its procedures for memory management that may mislead potential purchasers of this compiler.

Mr. Robie confuses the issue of memory allocation for Macintosh programs. He says that "DeSmet C uses a small memory model that limits you to 32K bytes of static data. Up to 32K bytes of additional data may be allocated by each called procedure. If you need larger blocks of data, you must allocate them on the heap." This is true. It is also true of every other Macintosh native code development system. The limitation is not tied to the way DeSmet C allocates memory, but rather to the 68000's use of 16-bit offsets in instructions using address-register indirect addressing. The Macintosh's segment loader, which is standard for all Macintosh programs, allocates a global (static) data area that is pointed to by register A5 at the start of the program. Most Macintosh development systems use register A5 plus an offset to refer to global variables. Based on Mr. Robie's description, I assume DeSmet C is doing the same thing.

The limitation of 32K bytes of data for each additional procedure is due to the way the 68000 LINK instruction is used. Most Macintosh routines that have local variables begin with a LINK instruction, which allocates space on the stack and sets a register (usually A4) to point to that automatic data area. Once again, the 16-bit offset limits the addressable size of this area to 32K bytes.

Currently, the only factors that stand in a potential purchaser's way are that DeSmet C is not one of the most popular C compilers for the Macintosh (and therefore will not receive the attention from third-party development tool developers that other compilers are beginning to receive); it does not compile very quickly compared to Lightspeed C, which is in the same price range; it does not have a symbolic debugger, which is rumored to be in the works for Consulair C; and it does not use the standard Macintosh user interface during development (something that Aztec C programmers appear to be dealing with quite successfully). The bugs mentioned in the review are, based on my experience, fairly common in C development systems for the Macintosh. Otherwise, the speed and small size of DeSmet C's generated code and its low price might make it attractive to some programmers.

MICHAEL SACKETT
New Hyde Park, NY ■

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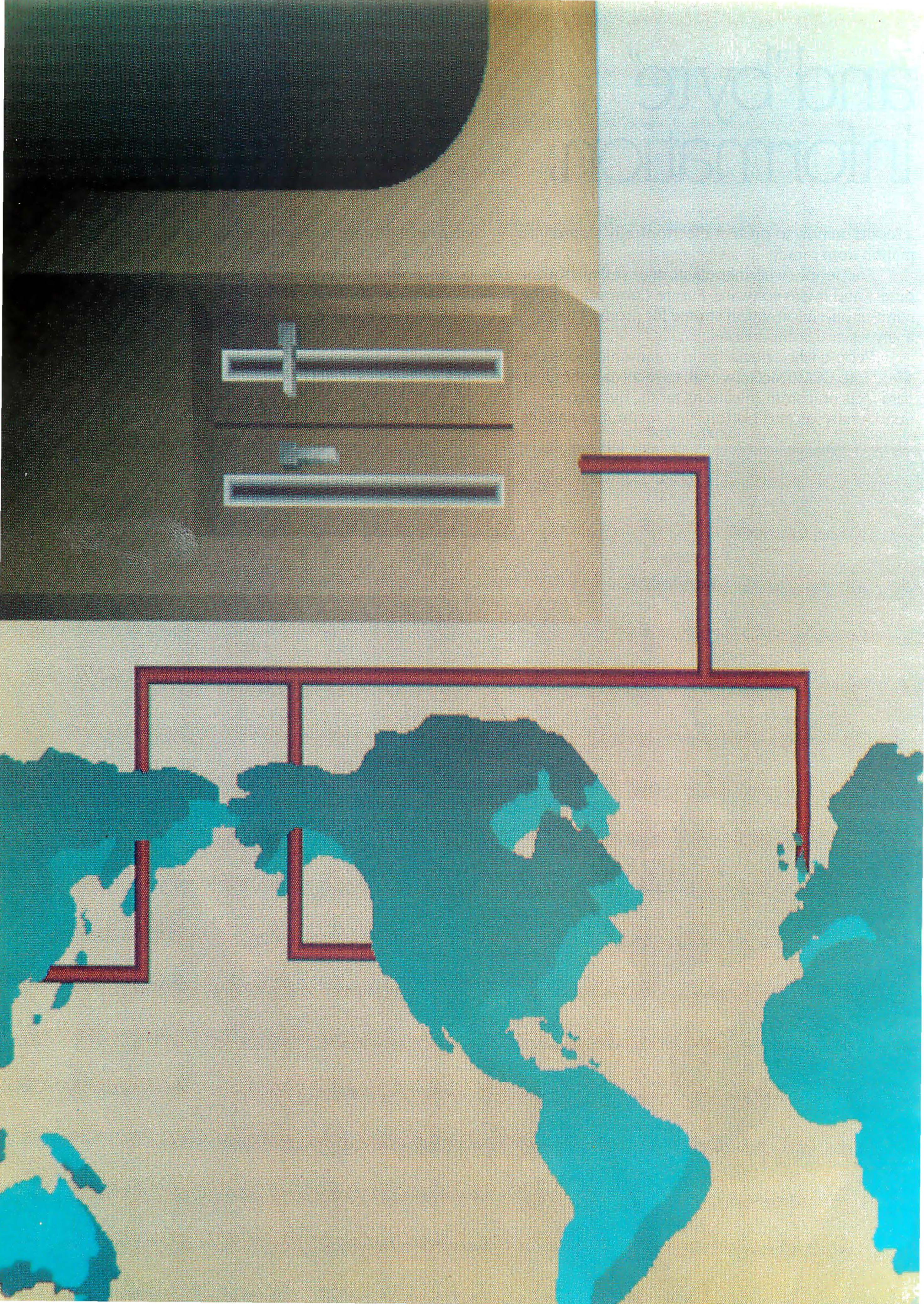
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Kernel

IS THE NATIONAL COMPUTER CONFERENCE a dying show? Jerry Pournelle believes this is a distinct possibility because of the way NCC treats the microcomputer community. That it was held in Las Vegas in late June was an added reason for Jerry to feel little enthusiasm about attending, but he did go. Unfortunately, his worst fears were confirmed—microcomputer companies were conspicuous by their absence. This did mean that he could comprehensively cover the show without sinking into a state of exhaustion. Jerry's top pick of NCC is a statistical analysis tool called MacSpin.

You may notice that According to Webster is shorter than normal this month. Bruce seems to think that he has a legitimate excuse for this, something about getting married. It appears to us to be a pretty weak excuse. What will he be asking for next—time for a honeymoon, time off because of illness? The nerve of some people! Seriously, all of us here at BYTE wish Bruce and his wife many years of happiness. And he still was able to do a column! Bruce's product of the month is Advanced Trace86, and he also considers a number of technical manuals.

Reflecting the public domain theme of this issue of BYTE, Ezra Shapiro looks at a number of shareware programs, all of them MS-DOS products. A great deal of shareware is being written for MS-DOS machines, mainly because of its large installed base. The program Ezra is most impressed with is Instant Recall, which calls itself "an information base not unlike the human brain." Instant Recall is helping Ezra overcome his disorganization. He also looks at a memory aid, some telecommunications programs, and a program to make your MS-DOS system look like a UNIX C shell.

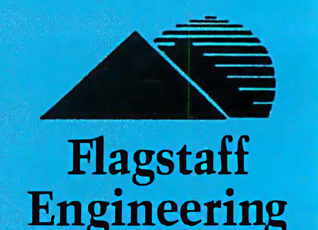
BYTE Japan could be called "BYTE Taiwan" this month. Bill Raike traveled to the new Taipei World Trade Center to attend the annual Computex show. While few IBM-compatible computers are found in Japan, Taiwan is different. Because of a small domestic market for personal computers, Taiwanese manufacturers must be active in U.S. and European markets. Computex therefore included a large number of IBM-compatible machines. One product that Bill was particularly impressed with is the Keystyle 80, a combination keyboard and laptop computer.

Dick Pountain begins BYTE U.K. with a brief discussion of BASIC. Even though BASIC receives a great deal of criticism, it remains the language that much business software is written in. However, business software houses are now faced with a growing base of multiuser UNIX systems. They are thus becoming interested in translating existing products into C, to make them easily portable from one UNIX system to another. The product Dick discusses this month, CGEN, provides an efficient way to translate Microsoft BASIC programs into C.

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THE SHOW GOES ON?

BY JERRY POURNELLE

Jerry sees some problems and some prizes at a moribund NCC

I went to the National Computer Conference this month. It has never been my favorite show, and this year it was in late June in Las Vegas.

It's unlikely to be there again. Las Vegas is for big shows; NCC was tiny, a mere shadow of its former self. There's a good chance it will continue that way, as the computer industry cuts back on the shows the companies can afford to attend. NCC has historically treated the microcomputer companies pretty shabbily—one year in Anaheim all the micros were segregated into the Disneyland Hotel a mile from the main show in the Convention Center—and this year the micro people simply didn't show up. The result was a disaster.

An immediate reaction would be "So what?" We have more than enough big shows; let NCC go back to what it used to be, an academic conference with emphasis on papers. Actually, of course, it never stopped being that; even this year there were plenty of papers, such as an excellent talk by Gopal Kapur on software design. Maybe that's the way to go. Why should NCC be so large that it can be held only in Las Vegas? Most of the academic speakers don't want to be there anyway.

Alas, the problem is revenue, which is important because NCC is a nonprofit affair operated by AFIPS, the American Federation of Information Processing Societies, and the revenue from NCC has subsidized AFIPS members like the Association for Computing Machinery and the Institute of Radio Engineers. Given NCC's checkered history, it's an open question whether the convention will continue to bring in money. It depends, I think, on what they've learned about the micro community.

Next year NCC meets in Chicago. Maybe we'll know then.

PICKS OF THE SHOW

AFIPS teamed up with *Fortune* to give the first annual Products of the Year awards. They'd originally planned a big sit-down presentation and had one of the exhibition halls of the Hilton set up for it, but then they got the grim truth: they couldn't even fill a wine and cheese reception held in a curtained-off area no larger than the Great Hall in Chaos Manor. I counted six press badges including my own.

AFIPS gave their hardware award to Plus Development Corporation's Hardcard, which I admit was quite an item when I first saw it more than a year ago. Their software award went to Telos Software's Business Filevision for the Macintosh. NCC's press release speaks of the "'Hardcard' product" and the "'Business Filevision' product," which gives you some idea of why not many people read AFIPS press releases. Neither of these "products" were shown at NCC.

Usually at a Las Vegas computer show I run as fast as I can and still don't see everything. I didn't have that problem this time. Here are my picks as best of the show.

First, MacSpin. A story goes with this.

NCC is put on by AFIPS and is thus supposed to have ties to the world of academia. Maybe so, but they treated the universities even more shabbily than they treated micros. NCC gave the academics ten or so free micro booths, smaller than those the West Coast Computer Faire gives to users groups; and although NCC couldn't fill the main hall, so that there were islands of empty space scattered all through the exhibit hall, they put the freebies out in a corridor underneath a stairway, where they were visited if at all by the Little Sisters of the Poor.

MacSpin was demonstrated at one of those booths. I'm not sure why; it's a commercial product. However, one of the coauthors is David Donoho of the University of California (Berkeley) department of statistics, which I suppose is connection enough, especially since it was by far the most interesting thing over there.

MacSpin is another of those programs like MacInTax and Excel that would tempt me to go buy a Macintosh if I didn't have one. The program is described as a "statistical analysis tool," which is accurate enough if not very appealing; it is really a way to make statistics fun for people who don't know anything about the subject. With MacSpin you can put up your data and look at it in odd ways. Do transformations. Look for hidden correlations. Find anomalies. The user interface makes it all as easy as MacWrite and is one of the best arguments for the Macintosh way of doing things I've seen.

The manual is quite good, with plenty of examples. You really don't have to know anything about statistics to use MacSpin to examine data sets and make interesting discoveries. The program is an example of what they call "dynamic graphics," meaning that

(continued)

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future.

MacSpin would be spectacular in color on an Atari ST or an Amiga.

you graph the data and then watch the graphs change as you do things. You can rotate (spin) data sets. You can also set up dynamic movements based on time. You can examine anomalous data points and hide or reveal them. I realize this all sounds a bit obscure, but that's my fault, not the program's. Five minutes of playing with it will make everything clear, and you won't have trouble learning how.

MacSpin comes with several interesting databases you can play with. These include some stuff about cars, a plot of all the galaxies we know of, and another data set on volcanoes. By just playing about, I learned things about all three that I never knew before. A new version, out about the time you read this, will have even more data sets; and of course MacSpin allows you to enter your own.

Alas, the program is copy-protected with the "insert master disk" variety of idiocy. There are other annoyances. For all that, the program is unique and a very great deal of fun. I recommend it about as much as I can recommend anything that's copy-protected. Maybe you should think of it as a game. I know I'm getting my high schoolers to play with it; it's fun, and they'll learn something. Incidentally, this thing would be spectacular in color on an Atari ST or an Amiga.

XEPIX

I like to get to shows the day before they open. I've learned a lot wandering about while the crews are setting things up, and it's also a good time to locate everything. I probably wouldn't have bothered if I'd known NCC was going to be so small, but habit prevailed, so there I was on Sunday afternoon.

The first thing I saw was an alligator. Not just an ordinary alligator, either; this one was green foam rubber with white teeth and had been turned into a hat. In fact, there were a number of them. "Where?" I asked the next person I saw with one. Once I had directions it wasn't hard to find. The alligators came from xePIX, a company I confess I'd never heard of before. I like to think I'd have paid attention to them without the alligators, but the gators made it certain. Once I had mine (his name is Wilbur, and he's in love with a vamp gator named Phyllis, but that's another story), I could look at what xePIX sells, which, as probably comes as no surprise, turns out to be a computer they call the Gator S/20.

The Gator S/20 is a 12.5-megahertz 68020 machine that sells with a 20-megabyte Winchester drive for slightly less than $5000. It comes with UNIX System V plus Berkeley enhancements, and from what I could see of it, the machine has as much bang for the buck as anything I know of. It competes nicely with Stride Micro's lower-end machines. Anyone interested in UNIX should look this one over. I'm not at the moment planning on getting a xePIX Gator since I don't hack UNIX, but my son Alex, who does, may talk me into trying one after all.

ZENITH'S NEW PORTABLE

I first saw this in the Zenith hospitality suite at Spring COMDEX, but we weren't supposed to talk about it then. Zenith has a nifty little two-disk portable. I don't have one yet, but I expect I will sometime. It weighs about 12 pounds, and as full-featured portables go, this is a good one.

The real question is, Who needs a full-featured portable? What you gain in capability by having those disk drives and full screen you lose in battery time, but especially in weight to carry. I can't remember the last time I had a burning desire to do a spreadsheet or compile a program while flying on a plane, or even sitting in a hotel room far from home. My NEC PC-8201 supplemented with a disk drive that I can send as checked luggage has been more than enough so far, and it's sure handier on an airplane.

However, I haven't tried carrying a truly portable full-featured computer, so I've no real basis for judgment. Maybe I'll find I can't live without it once I have one. Odder things have happened.

AEGIS ANIMATOR

My colleague Bruce Webster is designing a computer game for the Amiga. I don't quite recall how it happened, but I've signed on as a consultant. A couple of weeks before NCC, Bruce and Jim Sachs, the project artist, came over to Chaos Manor to talk about it. I'd previously seen some of Sachs's work on an Amiga, and I was impressed; he brought more, including a spectacular self-portrait. One thing we had agreed on was that the game would take place in and use spaceships from my Aeneas MacKenzie story line. Those ships are fairly complex. They never experience atmosphere, nor do they "land" on anything larger than a big rock, so there's no fairing or streamlining. Mostly they look like a complicated mess of tankage, except that there are rocket motors, access tunnels, and suchlike. While Bruce and Jim were here I did some very crude pen and paper sketches of one of the ships.

At NCC, William Volk of Aegis found me at the BYTE booth. He was carrying a disk with my spaceship as rendered by Sachs. There was only one problem: Commodore wasn't at NCC, and we hadn't seen anyone with an Amiga. Eventually we found one at the Juki printer exhibit. I think it was the only Amiga at NCC.

My ship had been drawn using Aegis Images and animated with Aegis Animator; they're packaged together. Bill got it running. There was some lead-in stuff, and then, wow, there's the ship, just as I conceived it, in living color, with shadows and everything. And it moves.

I know for a certain fact that this was done in no more than a week—they didn't have the ship design longer than that.

I'm told by some Amiga experts that Aegis Draw is solid, but with Aegis Animator you'd better save your work pretty often; there are

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some bugs that interact with the Amiga's operating system (or lack thereof) to crash things unpredictably. The Aegis designers confirm this. The bugs aren't fatal, and as bugs are reported they kill them, so that by the time you read this it ought to be fairly solid. I'd still be careful, but I always tell people to be careful with creative work; even if your program is bulletproof, power failures do occur. And wow! can you draw animated stuff with that program.

OS-9 AND ATARI

The only Amiga at NCC was used to show off Juki's new color printer, which, incidentally, does a pretty nice job; they used it to run off a picture of my spaceship. The printed picture wasn't much compared to what was on screen, but it wasn't all that bad either.

The only Atari ST at NCC was in the Microware booth, where, they tell me, it was running on OS-9.

All I know about OS-9 comes from BIX, which has a conference moderated by someone determined to tell you more than he knows about the operating system. Alas, I haven't had time to read all the excellent material he has posted, so I know almost nothing. I do know that OS-9 is multitasking, has some similarities to UNIX, and can generate fanatic enthusiasm in some of its users. It has been around long enough to be quite stable and well understood. At the moment you'll find it mostly on Tandy's Color Computer. (Incidentally, Tandy wasn't at NCC either.)

What makes OS-9 potentially important is that it is part of the CD-I (compact disk interactive) standard. That standard was reiterated by Philips and the Sierra Group at NCC and seems to have gone from straw man to tin man status. CD-I is a way of making a compact audiodisk player do double duty as a massive read-only data storage device. It is hoped that in a few years there will be as many CD-I players as there are now phonographs.

The CD-I standard also mandates a 68000 chip in the disk player, meaning that the player will really be a computer even if it only looks like a

component of a hi-fi set. Add OS-9, and 100 megabytes of stored data that can include picture, text, and programs for the CD-I's 68000 to execute, and the potential is pretty high.

The Atari ST runs under GEM, which is a reasonable operating system—it's in many ways preferable to the Amiga's incomplete operating system whose features are mostly distributed through folklore—but from everything I hear, OS-9 will be much better. We'll see; I'm supposed to get a copy to review Real Soon Now.

At the moment, though, Microware wants about as much for OS-9 as Atari wants for an Atari ST, so I can't think OS-9 will have much impact until that situation changes. Microware sells OS-9 largely to developers, who want a stable operating system environment. Clearly they're skimming cream. I don't think that's a wise marketing strategy. Done right, OS-9 could take off; marketed this way, who knows?

LASER PRINTERS

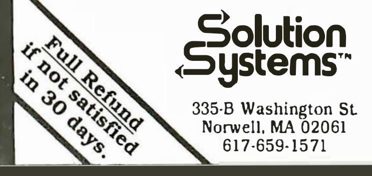
This is clearly the year of the laser printer. There were plenty of them at NCC. In fact, I predict that in another year or so, you won't see any daisy-wheel printers: everything will be either dot-matrix or lasers, with the lasers gaining predominance. Of course, there aren't any color laser printers. Yet.

A year ago just about all laser printers were based on the Canon engine. That's no longer true. I think Canon still dominates, but Ricoh is breathing hard down their neck. Ricoh engines are said to be more economical—you replace toner rather than a full cartridge—and potentially faster than Canon. They also stack the output upside down so that the sheets are in the right order.

I have two laser printers, both based on the Canon, and I've been very happy with them. One, the BDS Model 630/8, thinks it's a Diablo 630. It has been more or less permanently taken over by Mrs. Pournelle and does yeoman service.

My other laser printer was one of the first LaserJets made by Hewlett-Packard. Just before I went off to NCC, HP made me an offer I couldn't

(continued)





refuse: if I'd ship my LaserJet off to their factory in Idaho, they'd not only overhaul it but upgrade it into a LaserJet Plus. I jumped at that chance. I have a lot of software that needs the Plus to show its full potential, including Brøderbund's desktop publishing package and Fontasy.

The LaserJet returned two days ago. There's nothing to hooking it up. The new Plus has both serial and parallel ports like the BDS. In fact, I don't use the parallel port since I talk to my printer through Applied Creative Technology's wonderful little Printer Optimizer—it can simultaneously accept serial input from Zeke and parallel input from Big Kat, the Kaypro 286i AT clone—but when I bring in a PClone to test, that port makes it very easy to hook it to a printer.

The Plus has some new features. There's more memory. It can handle more complex graphics. It seems to run faster, although that may be an illusion. It comes with instructions for hooking it up to a number of different computers, including the Apple IIe and Apple III. Alas, it doesn't say how to connect it to a Macintosh. I have, in fact, got it running with the Mac, but that's through Microsoft's (alas) discontinued MacEnhancer connect box.

You can use the HP LaserJet and LaserJet Plus with the Macintosh, using ScenicSoft's ScenicWriter software. ScenicWriter makes use of *all* the LaserJet's font cartridges and uses the LaserJet's graphics capabilities to do Macintosh graphics files, calendars, and the like. They're perpetually improving ScenicWriter; if you have a Macintosh and a LaserJet, you probably ought to know about ScenicWriter.

IBM PC users who like Microsoft Word will want to know about FancyWord from SoftCraft. This program looks like a fancy printer to the text editor—but a printer with a lot of type fonts, including Old English, Times Roman, math, and foreign languages. If you're into fancy printing, this program's hot. It can even do kerning, which is the process of changing the spacing between certain letter pairs to improve the appearance of the final product. FancyWord marries Microsoft Word to present you with the various font options, and of course "what you see is what you get." It's not copy-protected.

LaserJet owners and those curious about them may be interested in *LaserJet Unlimited* by Ted Nace and Michael Gardner (Peachpit Press, 2110 Marin Ave., Berkeley, CA 94707, (415) 524-0184). The book was printed on a LaserJet and shows some of what the printer can do. I doubt that I'd have paid the $24.95 they want for a 212-page book, but it does conveniently summarize a bunch of information, such as which Macintosh programs let you print on a LaserJet and what some font programs will do. It isn't anywhere near as complete as I'd like; for example, the entry for ScenicWriter is confined to a line saying a program of that name exists. They also think

that Applied Creative Technology is "APT," they don't give the company's address, and they don't tell you that the Printer Optimizer can reformat text on the fly. This is a book for those who collect everything or those who can find a used copy at half price.

Meanwhile, back to the LaserJet itself: what can you say about a printer? The LaserJet Plus is quiet, reliable, and fast. An increasing amount of software recognizes the LaserJet as a standard printer; and with the Printer Optimizer you can painlessly transform nearly any program's output protocols into something the LaserJet will eat. You *can* get much better print quality—the Apple laser printer, for example, is only a little inferior to a phototypesetter—but you'll pay for it, and you may not need it. Certainly the LaserJet Plus is more than good enough for general office work.

I suppose the wrap-up line is that when Larry Niven wanted a new printer, I got the name of the nearest HP dealer and sent him off to buy a Plus.

I do wish, though, that some company would print checks on sheets I can feed through the LaserJet; I'm getting really weary of hauling out the NEC Spinwriter once a month just because it has a tractor feed.

READY! AGAIN

One way I've been keeping organized is with Living Videotext's memory-resident Ready! program. Ready! has its frustrations. The user interface takes getting used to, but in fairness once you've learned some of its quirks it isn't so bad. The worst glitch turned out not to be Ready!'s fault at all.

I have a bunch of Ready! files. One of them is called "Columns," and whenever I find out something that ought to be in a column, or find a program I particularly like, I can make a memo. (Incidentally, I am growing more and more weary of short filenames.) The program added .RDY to the filename. So far so good, and I was able to pop in and out of "Columns" whenever I came across something I wanted to make note of. I even began to feel organized.

Then one day I entered Ready!, and when it gave me a list of filenames, "Columns" wasn't in there. In panic I exited and looked in the directory. No problem. Back into Ready!. File didn't exist. I typed in "Columns" as the file to be loaded. "Can't Open Textfile!" the program told me rather breathlessly. I typed in "COLUMNS.RDY". Same result. "Can't Open Textfile!"

"Unbearable," I muttered and pushed Ctrl-Alt-Del. After the machine reset, the program had no trouble at all finding "Columns." I put it down to memory drift. Then it happened again. In fact, about one day out of two it happened. I was ready to give up Ready! for good.

Then it happened that I reset to get out of some dumb program that locked up my machine, and since it had happened maybe five times, I tipped the program into the round file and decided to answer my BIX mail. When I reset Big Kat, the autoexec program brings in SideKick, SuperKey, and Ready!. When I do BIXing I have a bunch of SuperKey macros that make life easier, such as Alt-down-arrow to stand for "Skip to Last," Alt-9 to stand for the complex series of keystrokes that mark a message in the SideKick notepad and get it set to upload to BIX, and Alt-A for a large "Aaarrrrgggghhhh!!!" comment, and suchlike. I loaded my macro, answered my mail, and while in BIX had a thought to record in the Ready! "Columns" file.

"Can't Open Textfile!" Ready! shouted smugly.

"That did it," thought I, and after logging off BIX I proceeded to reset with the intent of removing Ready! forever. Once I had reset, it worked fine, of course. It couldn't be drift. I'd reset a minute before—

You've probably figured it out already. It took me another 10 minutes.

If I invoke Ready! immediately after resetting, the program works fine, and I can read in "COLUMNS.RDY" and any number of other Ready! files. On the other hand, if I first read in my BIX SuperKey macro, Ready! is brain-damaged. It's as simple as that. Apparently Ready! marks off the memory area it wants, and SuperKey doesn't, since my BIX SuperKey macro works fine if read in after the Ready! file. It's annoying to have to remember to invoke Ready! instantly after resetting, but that's better than getting along without either Ready! or SuperKey.

I suppose there's a moral to this story.

Word Finder is a synonym program that blows away its opposition. It's fast.

WORD FINDER

I met Mike Weiner at last fall's COMDEX. Cary Lu (whose *The Apple Macintosh Book* is still the best one out) and I were in the pressroom when Mike came up and introduced himself. "I'd like you guys to see something," he said. What he wanted us to see was in the Desert Inn, a good long walk at an hour when cabs weren't to be had, but he persuaded us.

What we saw was an on-line search system that makes Turbo Lightning look slow. Mike Weiner used to work at the Xerox Palo Alto Research Center and watched them develop technological marvels, none of which the company seemed interested in marketing. Finally Mike couldn't stand it any longer and went out to start his own company, Writing Consultants, which is a division of Microlytics, and what all that means I don't know. What they do is market neat hacks.

Their first one is Word Finder, a synonym program that blows away its opposition. It's fast. I mean really fast; and it has an enormous vocabulary. You can measure how large by the fact that William F. Buckley Jr., who certainly has the largest working vocabulary of anyone I ever met, calls the program a "bloody miracle" and says in print he wouldn't be without it.

Word Finder has something like 200,000 synonyms, far more than Lightning. The dictionary includes some really odd words. The program works painlessly with most text editors, including Microsoft Word,

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WordStar, and WordStar 2000. It will also work with the SideKick text editor, although for reasons I don't quite understand, the text has to be white. It works with XyWrite version 3.041 or later, but only if you use one of the (slower) keyboard modifications XyWrite supplies.

Using Word Finder is simple enough, and if you find a word you like, the program will insert it into your text. In general you don't want a thesaurus program when you're writing; it's when you've got a draft and want to improve it that Word Finder comes in handy. Bruce Tonkin has recently done a program that finds words repeated within a couple of paragraphs of each other (there's a way to tell it not to bother with a long list of simple words like "the," "to," and the like); I'd think Word Finder might be ideal to go with that, and I'm going to recommend it to my editors. (But alas I haven't tried it yet.)

I have only one reservation about Word Finder. When Turbo Lightning first came out, I leaped on it with considerable enthusiasm; but over the next few months I found I used it less and less, until eventually I removed it entirely. It's not that I don't like the program, it's just that I find I don't use it. I now find I have great enthusiasm for Word Finder, but I can't tell how long that will last.

Of course, one problem is that I don't normally write on an IBM PC; for all my wriggling around, I haven't found anything I like better than old Zeke the CompuPro Z80 for just whanging the words out. That means that to use Lightning I'd have to copy my text files onto a PC-DOS disk—no big trouble for a CompuPro—and read them into a text editor on the PC. The problem with that is that I still haven't selected an editor to use with the PC. I can see I'll have to do that, preferably one that can read in ASCII files.

Anyway, if you are looking for a thesaurus program, this is the one to get.

WILDERNESS

If you read *Footfall* by Larry Niven and Jerry Pournelle—surely you have read it?—you'll recall Charley Kohlhase, the JPL mission planner for the *Voyager* spacecraft. Unlike most of the characters in that book, Charley is quite real, and the scene at JPL when *Voyager* encountered Saturn is very accurate. (Larry and I were there.)

Charley has partnered in the design of a remarkable computer game. I've mentioned Wilderness before: the game can run on an Apple II. When it does, it's very slow. Now there's a new version, and on a PC, and particularly on an AT, it zings.

Wilderness simulates travel through primitive terrain at different times of the year. The default game is the High Sierra in May. Your airplane has crashed. You have limited supplies and a topographical map showing the

location of the ranger station. What you don't know is where you are. Wilderness lets you scan the world, looking up, down, and ahead, and turning to any compass point, or just panning around. Out there you see hills, forests, lakes, and suchlike.

You can then switch to the topographical map. The game map is missing some of the symbols and margin information of a real one, but that's all right: what's important is that it's a pretty accurate map of the terrain you're looking at.

I have found that most Boy Scout troops that come to the High Sierra from, say, one of the flatter states have learned a lot from books. They can read maps. What they can't do is turn those map squiggles into a knowledge of the terrain. Our mountains can be pretty confusing. If Wilderness did no more than give exercises in reading topographical maps and orienting yourself against real terrain, it would be worth the money.

In fact, though, it does more than that. The game does a good job of simulating thermal balance and hypothermia: if you're caught out in the wind without much food or clothing, you're in trouble, and the game shows just how frighteningly fast those conditions can kill you.

Moreover, if you're pretty experienced in the mountains, you can use the game to build yourself a jungle scenario or an arctic puzzle. As a fun game for an adult this is sort of so-so, but as an instructive tool for those about to head into the wilderness this has real possibilities. Every year I take Scouts into the Sierra, and there are always some I wish had spent a couple of weeks fooling with this game. For that matter, every year I see adult leaders I wish had played Wilderness for a few hours.

A Whole Bunch of Stuff

It's time again to clear out about ten dozen entries in my notebooks.

This is always a dilemma: do I wait until I have time and room for full discussions, or do I throw in a quick paragraph about "this is good stuff, have a look at it"? If I decide to wait, it might be a long wait. Anyway, it's time for short shrift at Chaos Manor. . .

Orchids

I have got a whole mess of Orchid Technology boards. Some of these merely speed up your PC. Others turn it into an AT, provided that you've got a hefty enough power supply. Others do nice things for color displays.

Every darned one of them works. When Orchid first started shipping stuff, I used to complain bitterly to them about their install programs and directions for using them, but even that's pretty well fixed. If you have a PC that is slowly turning into an anvil, look into Orchid Technology. I've

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Generally everything you can do in DOS can be handled by the Commander, either by commands, arrow keys, or using a mouse.

yet to find anything they sell that I don't like.

Dan Bricklin's Demo

This is the damnedest program you have ever seen. What this thing does is let you simulate programs you haven't written yet. Want to show the local vulture capitalists what your program will look like once it's developed? Use Bricklin's Demo Program.

The Demo Program lets you build screens and bring them up through a series of commands. Screens can be linked to each other. Thus, you can set it up so that it really looks like your complicated program is running. The result can be impressive. If you need something like this, you need it bad. Every PC software developer probably ought to have one, since one way to see if your user interface makes sense is to simulate it and let a naive user try it out.

The Norton Commander

Like all of Peter Norton's stuff, this works as advertised and has good instructions on using it. The Commander is a disk management utility, combining the features of PC-Sweep and other such public domain stuff with a mouse-drivable command menu system. For example, you can tell the program that all data files with a .TXT extension are to be run by, say, Microsoft Word, after which you can "point and shoot" at the data file and the Commander will do the rest. Copying, deleting, path management, directory changes, and generally everything you can do in DOS can be handled by the Commander, either by commands, arrow keys, or using a mouse.

I was quite impressed with this and with the tutorial that came with it. I went through the tutorial, decided I liked the program—and promptly went on a trip. I haven't used it since I got back, which may or may not be meaningful. If I used Big Kat or some other PC machine most of the time, I'd probably be more tempted.

The Commander advertises itself as for "power users"; I'd say it's more for people who aren't power users but would like to be. Real power users either don't need this or know how to find it all in the public domain.

Mind Mine

If you have an Atari ST, you need to know about Mind Mine Computer Center (13256 Northeast 20th St., Suite 4, Bellevue, WA 98005). They make all kinds of accessories, including real-time clock board kits and the like. Last month I mentioned their memory expansion for the Atari 520ST; it's easy to install and makes a 520 zing. They've got a whole bunch of other stuff, all simple to install, with some of the clearest and most explicit directions I've ever encountered. Write, get on their mailing list, and keep up with the latest.

Guru

This one's far too complex to deal with in short shrift, and I won't; but I do want to get on the record that I am impressed with this program.. If I had to build a complex specialized database for naive users, the chances are very good that I'd use Guru. Its only rival I know of is Q&A, and while Q&A's Intelligent Assistant is pretty good, it's not got a patch on Guru.

I've had a long and complicated relationship with Micro Data Base Systems; I've always said their database system was about the best thing around, provided that you really understood what databases were all about, but that their documents were designed for experienced professionals. That's still true. I'd never hand Guru to a beginner. In proper hands, though, this program can do some incredible things. A lot more on this one later.

Dragonquest

Bob Albrecht (P.O. Box 7627, Menlo Park, CA 94026) is one of the original pioneers of the micro revolution. He has spent the past 10 years trying to make these little machines accessible to others. One way he does that is to publish *Dragonquest*, which he calls a "family newsletter." It says it's free, although I can't think he could afford to send thousands of them. Anyway, *Dragonquest* has a whole bunch of school lessons (6th grade or so), homilies, exercises you can do with computers, and just generally fun stuff to help in teaching computers to kids and also using computers to teach kids.

They're changing the name of the newsletter to *Adventures in Learning*. That's apt. If you're into sharing knowledge, you need this newsletter.

CAD

One of the silliest things I've done recently (it was in another magazine so it doesn't count) was to imply that the best way to use the Amiga for CAD was to get the Amiga Sidecar that turns the machine into a PClone. Now there's a sense in which that's true: the original AutoCAD program from Autodesk is still the standard professional CAD tool; but I also mentioned Generic CADD for the PC, which, while a very good PC program and one I recommend, isn't necessary for Amiga users. After all, there's Aegis Draw, from the people who made the Animator Sachs used to draw my ship.

Aegis Draw needs 512K bytes of memory and two disk drives, and it helps to have a hard disk. If you expect to do much with the drawings you produce, you'll need a plotter. Given those, you can make multilayer drawings, dimension them, build files of parts, and generally do most of what you expect CAD systems to do.

Winding Down

One thing I regret about the frantic pace I've been living at is that I haven't had time to play around with

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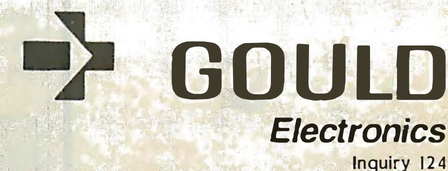
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Turbo Prolog. Even discounting Philippe Kahn's enthusiasm by a factor of five—he gets enthusiastic about whatever he's working on—Prolog has to be worth knowing something about. Philippe thinks it's the language of the future and one that every computer user should learn.

I'm not sure he's wrong. Prolog is not just another computer language, it's another *kind* of language, so that exposure to it can't do anything but good; and the Borland manual is concise, clear, and has examples. I've been reading it in the bathroom. Next month, with luck, I'll have created a couple of Prolog programs.

The book of the month is Michael

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Wilderness $49.95
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Thousand Oaks, CA 91360

Word Finder $79.95
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East Rochester, NY 14445
(716) 377-0130

Z-181 Portable Computer . . . $2399
Zenith Data Systems
1000 Milwaukee Ave.
Glenview, IL 60025
(312) 391-8949

Wood's *In Search of the Trojan War* (Facts on File Publications, Oxford, U.K., 1985). It is a selection of the History Book of the Month Club. I've always been interested in the High Bronze Age, and this book gives a good account of the myths, archaeological records, and other known data of the period of the Trojan War.

The computer book of the month is by Elliot B. Koffman: *Turbo Pascal, A Problem Solving Approach* (Addison-Wesley, 1986). It's written as a textbook and here and there the author remembers that, to the book's detriment, but in general the book is clear and contains lots of example programs. Take this book, Turbo Pascal, a PC, and a few weeks' time, and you'll be a better programmer than many of us were back in the early days.

On strict time spent by me, the game of the month still has to be Sir Tech's Wizardry for the Macintosh, but I refuse to admit that; so the game of the month is Geometry from Brøderbund Software. Geometry isn't strictly a game, of course: this Macintosh program is really a one-year high school geometry course packed onto a couple of disks. The kids don't have to know that. Remember all those screwy constructions we used to do? The "14 point" circle thing, and inscribing triangles, and all that? It's all here, only now you don't need colored pencils and a compass to poke holes in the paper. I actually found it fun, and I'm going to spring it on the boys as a game.

And that's enough. Tomorrow Mrs. Pournelle and the boys collect me for three days on the San Diego beaches, followed by the Westercon Science Fiction Convention; so before I go to bed I have to check the final report of the Citizens Advisory Council on Space Policy, answer a dozen letters, and get this column onto BIX. It's a great life, and I haven't weakened yet.

Jerry Pournelle welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. ■

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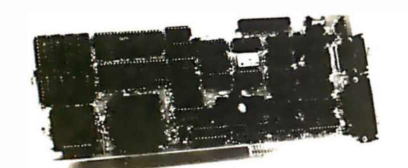
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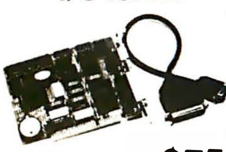


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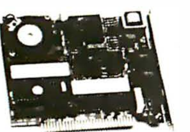
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Bit by Bit, Putting It Together

BY BRUCE WEBSTER

Computers take second place this month as Bruce says "I do"

It's now late June as I write this. I'm about 32 hours away from getting married and thus am working under some real deadlines (the nominal ones having passed about a week ago). This column was originally going to be Round 3 of the 68000 wars, but fate stepped in, killing some of the hardware on hand and delaying other hardware shipments. It looks like I'll be able to get to that next month, but in the meantime, this is going to have to be short: I've got a wedding to go to.

Assembly Language

My first programming language was IBM 360 assembly language, taught to me by Dr. Alan Ashton, who went on to fame and fortune as coauthor of WordPerfect and cofounder of Satellite Software International. The experience—two semesters' worth—made me eager to move on to higher-level languages, due to my own laziness and sloppiness; assembly language programming tolerates neither. (It also left me with an aversion to IBM from which I have never completely recovered, but that's another story.) As fate would have it, though, I have repeatedly had to delve into assembly language programming over the years, on machines ranging from mainframes to microcomputers. Each time I had to go through the learning curve of becoming familiar with registers, instruction sets, condition codes, and other machine-specific data. As my familiarity with the particular machine increased, I found myself enjoying the assembly language coding more and more. But, of course, that project would end, and some time would pass before I found myself having to learn yet another assembly language for some new task, groaning and grumbling as I did.

Well, it's been two years since I've had to do any assembly language programming, and for the most part I haven't done any. Oh, there's been a little tinkering here and there, but that's about it. It's been easy for me to stick with Pascal, with some ventures into C, Modula-2, FORTH, and other languages not specific to a given processor. But recent events have forced me to get off my fat attitude and start twiddling bits again. First, I begin teaching an assembly language class this week, using Apple IIs (and, hence, 6502 assembly language). Now, I've done a moderate amount of 6502 coding—there's a product on the market that has 3000 to 4000 lines of 6502 code written by me—but it's been a long time since I wrote it, and I've managed to forget more than I care to think about.

Second, Morgan Computing finally sent me a copy of Advanced Trace86—an 8088/8086/80286 assembler/debugger—to review, which of course requires that I bite the bullet and start learning 8088 assembly language. Third, I've collected more than half a dozen books on 68000 programming, including three specific to the Macintosh. I've also received review copies of assemblers for the Mac and the Atari ST, and I need to look at reviewing them. I think I see the handwriting on the wall, and it says MOVE.W (A3), -(SP), or something like that. So starting this month, look for greater coverage of assemblers and books on assembly language in the column. I need the practice. And speaking of which . . .

Product of the Month: Advanced Trace86

And here you thought I had an unreasoning prejudice against the IBM PC and 8088 processors. Yes, Advanced Trace86 ($175 from Morgan Computing, P.O. Box 112730, Carrollton, TX 75011, (214) 245-4763) has made it to the Webster Hall of Fame simply because it finally got me to do what I have been avoiding for a few years now: learning 8088 assembly language. Now, lest you think I'm biased against all Intel (or Intel-derived) products, I should point out that I had done a fair amount of 8080 and Z80 coding, and a software package on the market contains a program I wrote entirely in 8080 assembly language. I sat down to learn 8088 assembly language, was put off by the segmented architecture, and never bothered to learn it. Until now.

Advanced Trace86 is, in simplest terms, an advanced version of Debug, the debugger that comes on your MS-DOS/PC-DOS utilities disk. Most of the Debug commands are there and work in pretty much the same fashion. The differences are what make the product such an excellent tool for learning assembly language. First, AT86 uses a screen-

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oriented approach. The top of the screen maintains a display showing register contents, flag status, command options, and the like. You then get a command prompt on the screen, and you've got a large command set to choose from (a quick-reference card and the built-in help function aid in keeping track of your options). From the command mode, you can go into a number of other modes: display (for memory examination and change), trace (for tracing execution of code), assemble (allows you to key in your own assembly language routines), and calculator (which uses the 8087 if present).

The display mode is a screen-oriented dump-and-modify mode that lets you view memory in ASCII and/or hexadecimal, move the cursor to the locations you want to change, and type in the new values. You can organize by byte, word, or double word. You can page up or down quickly. It works nicely.

The trace mode gives you extensive single-step and breakpoint-based execution of code in memory. During execution, the stack is displayed to the far right of the screen, and the disassembled code is always kept visible, with an inverse bar indicating the command currently being executed. Additionally, you can request a memory window at the bottom to examine data being read or written. It also works nicely.

The assemble mode puts you into a BASIC-like interpreter that gives you the power to easily insert and delete lines, declare data storage and initialize it, use labels and variable names, and save it all in a special .COM file format that preserves all symbols (names) for future AT86 work. Very, very nice.

The calculator mode calls up an RPN (reverse Polish notation) calculator that lets you perform numerical and logical operations on hexadecimal and decimal values. If you have an 8087/80287 in your computer, another version of the calculator gives you high precision and access to many trigonometric, logarithmic, and other math functions.

Other features? Well, there's an Undo command that lets you single-step backward. You can specify how many steps back it should remember at the time you execute AT86; the default is, I believe, 20 steps. You can make AT86 memory-resident and call it (or its 8087 calculator) while in the middle of another task. You can call up a DOS shell from within AT86, execute DOS commands, and then return to AT86. You can use a "super trace" mode that allows you to enter a condition on which tracing should pause.

There are even more options and commands that I haven't explored yet, but I intend to get around to them. And I might even become halfway decent at programming in 8088 assembly language. If you're interested in learning 8088 assembly language, or even if you're just looking for a good debugger, your best bet is probably Advanced Trace86. Check it out.

8088 Assembly Language Primer

Of course, Advanced Trace86 didn't teach me 8088 assembly language all by itself. In fact, the AT86 manual

gives very little information about 8088 assembly language. And so, even being the good product it is, it still would have left me in the dark if I didn't have a copy of *Assembly Language Primer for the IBM PC and XT* by Robert Lafore (New American Library, 1986, $24.95).

This book provides an excellent introduction to 8088 assembly language and to the IBM PC itself. In each chapter, Lafore introduces a number of concepts, 8088 instructions, DOS calls, and Debug or assembler commands. Lafore assumes that you have both Debug and an assembler (ASM or MASM); I was able to get through most of the book (and most of the examples) just using AT86.

Be warned that the book is just a primer and doesn't have all the information you need to become proficient in 8088 assembly language programming. I'm now in the market for a good advanced text so that I can fill in the gaps that remain. But I'm grateful to Robert Lafore for making things painless enough to get me started.

TECHNICAL MANUALS

I've been building up a growing library of computer-specific technical documents published by a number of firms, and this is probably as good a time as any to list them. First, Addison-Wesley has published the definitive version of *Inside Macintosh*. You can buy it as three softbound volumes or as one large, heavy, hardbound volume (for $79.95). Or, rather, a hardbound version of all three volumes together. I have the hardbound book and find it a significant improvement over previous Apple-published editions (loose-leaf and "phone book"), if just in that it's easier to find a given section. It is still not an easy manual for a Mac novice to get through: Sample code is scarce, and each section tends to require knowledge in other sections. But once you've learned the basics of Macintosh programming (probably from some other source), it's the book to have to look up those routines you need.

Addison-Wesley is also publishing the Amiga technical manuals. I've received all four: *Amiga Hardware Reference Manual*, *Amiga Intuition Reference Manual*, and both volumes of the *Amiga ROM Kernel Reference Manual*. These manuals cost from $23.99 to $33.95, are much easier to get into, have more of a developmental approach (i.e., succeeding chapters in the manuals build upon information that has been been discussed before), and sample code is easier to locate, although it is still more scarce than Amiga source code should be.

Abacus Software (P.O. Box 7211, Grand Rapids, MI 49510, (616) 241-5510) is publishing a series of books on the Atari ST, all of which showed up in a box on my doorstep a week or two ago. I haven't had time to do more than quickly flip through them, but they look as though they should be a great deal of help, especially given the poor quality (to date) of ST technical documentation from Atari. The titles I received include *Presenting the Atari ST*, *Atari ST Internals*, *Atari ST GEM Programmer's Reference*, *Atari ST Machine Language*, *Atari ST Tricks and Tips*, *Atari ST Graphics and Sound*, and *Atari ST BASIC Training Guide*. Prices aren't printed on the books, but they appear to range from $17 to $20 each. I'll give a more detailed review as I use them, but right now the *GEM Programmer's Reference* looks to be the most valuable of the series, simply because the "official" GEM manuals come only with the $300 developer's kit (and yet you need to know the GEM calls to do most serious development on the ST).

For the IBM PC? Well, I spent a lot of time browsing at the book rack and decided I was best off with *The Peter Norton Programmer's Guide to the IBM PC*, published by Microsoft Press at $19.95. Lots of tables, charts, diagrams, and examples. It also brings home how much less complex the IBM PC is than the three machines above. One volume pretty much does it all.

IN THE QUEUE

Well, if all goes well, I will have the following to cover for the next column: the Macintosh Plus (Apple has already sent me one), the Atari 1040ST (one is supposedly on the way), the Prodigy 4 from Levco (16-megahertz 68020, 68881 math coprocessor, 4 megabytes of RAM, 20-megabyte hard disk drive, all inside a Mac), the HyperDrive 2000 from General Computer, and maybe a few more surprises. I've also got three books on programming in assembly language on the Mac to look at. Until then, see you on the bit stream. ■

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SHAREWARE

BY EZRA SHAPIRO

Instant Recall, TSRCOM, *Pibterm, ProComm, Qmodem, and PC-Shell*

Writing about shareware is always troublesome. I know very well that all the programs below will have changed, sometimes in major ways, between the time I write this and BYTE's publication date.

This volatility represents both shareware's greatest weakness and its greatest strength. Since this type of program is rarely developed by more than one or two people, there is a constant risk of bugs—leading to a cascade of revisions. Big commercial companies can afford to conduct extended testing, and they can hire hordes of programmers to catch mistakes that slip by the independents. On the other hand, because there are no huge manuals to reprint and no retail inventories to be replaced, shareware firms can respond to problems and add new features with amazing speed.

All the programs I've selected for this column are MS-DOS products. More shareware is still being written for MS-DOS machines than for any other type of computer, largely because of the size of the installed base. That's not to say that good stuff isn't being developed for the Macintosh, the Atari ST, the Amiga, and machines running other operating systems. Good stuff is available, and I'll try to get to it in future issues.

You can find all the software mentioned in this column on local electronic bulletin board systems, and you can often obtain copies from users groups and computer clubs. I've uploaded the most recent versions I have to both BYTEnet Listings at (617) 861-9764 and to BIX, BYTE's computer conferencing system. Speaking of BIX, while you're on-line you ought to check out Barry Nance's program called BIX.COM, a shareware MS-DOS communications package designed specifically for use with BIX.

A NEW MASTERPIECE

I am not a fanatically organized individual. I scrawl notes on odd scraps of paper. I pretend that my basic record-keeping system is a collection of manila folders, but mostly things accumulate in piles on the floor. I haven't computerized my address book because I haven't figured out a reasonable way to set up the fields in a traditional database. But it's time to set off the fireworks—my scattered data has finally met its master.

According to the message on the box, **Instant Recall** (Precept) is "an information base not unlike the human brain." That's it exactly; the program is a memory-resident—or standalone—database manager that gives you the chance to store free-form text in haphazard pieces and call it back later in an organized fashion. I'm using the phrase "database manager" loosely; an Instant Recall "record" is simply a block of text up to 60 lines in length. You create a record by cutting data from an application program and pasting it into Instant Recall, by pulling in an external file, or by using the program's built-in rudimentary editor to write it on the spot.

Don't bother with highlighting keywords or assigning field names: Instant Recall indexes every word in the database. When you want to find a record again, just feed Instant Recall *any* words you've entered and the program retrieves all the records that contain those words. Searching is lightning fast; Michael Fremont, the program's author, claims Instant Recall can find any record in a 2-megabyte database in less than 20 seconds.

The program has only 16 basic commands, triggered by control keys, that let you build and manipulate records. Though Instant Recall is not intended to be a replacement for a word processor, it has enough editing commands to let you hop around and modify text with good flexibility. Cut-and-paste works for transferring data between records, as well as to and from underlying applications. You can also import and export text, with either fixed- or variable-length records, as ASCII files. If you mistakenly delete a record, or if you want to salvage the original version of a record you've modified, Instant Recall lets you resave records from an "Undo" stack of the last ten deleted or changed records.

The search engine accepts words and three sorts of dates as criteria—date of creation, date of last modification, or a reminder date (more on this later)—that can be strung together with logical operators. Thus, it's possible to ask for any record containing references to BYTE and October that was either created or modified during June or July. In fact, you can have as many as seven ANDs and seven ORs in your search parameters.

To test Instant Recall's capabilities as a data-retrieval system, I created a monster text file. I downloaded the entire MS-DOS conference from BIX, which turned out to be a bit less than a megabyte of messages ranging

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The author of Instant Recall has wisely resisted suggestions to clot up the program with too many features.

widely in length. Using good old WordStar 3.3's search-and-replace, I added a record-terminator character (a tilde) to the end of each message. Then I told Instant Recall about the terminator and commanded it to suck in the file as individual records. This was not a quick process; even with my Fast88 (a wonderful little add-on from MicroSpeed that lets me switch my Compaq between 4.77 and 7.4 megahertz on the fly and that speeds up video scroll and disk access), it took about 45 minutes to complete the job. Still, that's not bad for a megabyte of text fragments. I can now use Instant Recall's Find mechanism to sift through the mess looking for strategic words or phrases.

There were only a couple of niggling annoyances in this exercise. Any text block bigger than Instant Recall's limit gets split into multiple records. Since I did not go through my file adding headers every 60 lines, the few longer messages were broken up, and the only way I'll ever get to see the parts is if each of them contains the words I specify in my search. I also found that with a 1-megabyte database (only half Instant Recall's limit), deleting unwanted records is rather slow; the program has to churn the disk as it reclaims space.

Finally, I pulled in quite a few garbage messages; I figure that only about 10 percent of what I got was worth saving. Instant Recall currently lacks the facility to browse the database in chunks larger than 64 records at a time, so pruning would be quite a chore. To be fair, I'd never do anything like this in real life; I'd either collect records one by one (remember, Instant Recall can grab text from a telecommunications program) or edit the raw file with a word processor. On the whole, I was terrifically impressed with the smoothness of this operation.

Fremont has wisely resisted suggestions to clot up the program with too many features. As a result, Instant Recall is compact and quick, and you can invent new ways to use it rather than be forced into a structured environment. I find it a great tool when I'm writing; not only can I keep tidbits of reference materials close at hand, I can use the cut-and-paste as a replacement for SideKick's notepad. I also store phone messages, expense records, useful trivia, and so on. Kind of like the piles of paper on the floor, but now I can always find things when I need them.

One of my favorite parts of the program is its reminder feature. You can attach a reminder date to any record. When the day rolls around, the record pops up the first time you use the program. As an example, you could add a reminder date to an address entry so that you'll remember to make an important telephone call or attend a meeting.

Now I'm not saying the program is perfect; it's relatively young and has a few rough edges. The version I tested lacked critical error trapping; when I tried to output a record without turning on the printer, Instant Recall departed for The Great Beyond. I didn't have any problems running the program in its stand-alone configuration, but in memory-resident mode there were a few conflicts with some of the weirder or older pop-ups (which isn't surprising). I'd like to see one or two additional editing commands, especially for deleting words and lines. And I'd appreciate the ability either to manage more than 2 megabytes or to switch between multiple databases.

But I'm writing this column approximately three months before you'll read it; I'm fully confident that Fremont will have run Instant Recall through a number of revisions in the interim. The program will be better, faster, and cleaner. It's already slick enough for me to be using it constantly; the incarnation you'll be able to get will be dynamite.

Instant Recall is distributed as "teaseware"; that is, you can get a free version with a database limit of only 80K bytes, which is actually quite workable if you treat the program as a notebook for brief reminders and short blocks. However, I'll bet that once you begin to explore the product, you'll discover so many uses for it that you'll want to purchase the 2-megabyte version.

Five gold stars for this one.

Memory Aid

If you find yourself shuttling gangs of resident programs in and out of memory, you shouldn't be without Kim Kokkonen's **TSRCOM** (TurboPower Software), a handy group of teeny utilities that simplify life with TSRs (an acronym for "terminate and stay resident" products).

One program lets you place a 1584-byte mark in memory before you load each TSR; a second program erases everything in RAM beyond and including the mark. So rather than having to remember the specific command sequence to unload any given pop-up (which is often obscure or, with some software, nonexistent), you merely run the release utility and free up your RAM. This is particularly useful when the TSR you load last doesn't have an escape hatch; without these utilities, you're forced to reboot your system to reclaim work space. It's also good insurance. When Instant Recall aborted when I tried to send a file to a dead printer, it didn't crash the system; Instant Recall just refused to work. Because I had placed a mark before loading Instant Recall, I was able to clear it from memory and reload it without disturbing the TSRs I had loaded earlier.

The collection also provides an excellent memory-mapping program that shows exactly what you've got in RAM, space used by each TSR, addresses, and hooked vectors; another program merely shows remaining free memory space (without grinding away to check disk usage as CHKDSK.COM does); and a third—probably useful only if you're developing your own programs or testing software—simply gobbles up RAM, so you can simulate

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a 256K-byte system on a 640K-byte machine.

I've tried the mark-and-release system with a number of TSRs, and it seems to work fine. The only conflicts have been with TSR products that have a history of bad problems anyhow.

Good stuff.

Comm Wars

Flat statement: Unless you absolutely need the ability to perform file transfers as a background task, there is no reason to purchase a high-priced commercial telecommunications program. At the moment, three shareware packages are vying for top honors: Pibterm (Philip R. Burns), Qmodem (The Forbin Project), and ProComm (PIL Software). All of them are as good as or better than anything on the market. My problem is choosing one to recommend over the others; each has a couple of specific advantages, but overall they're so close in function you'd be better off picking up all three and choosing for yourself.

They all owe a major debt to PC-Talk, the original MS-DOS shareware communications package. They look a lot like PC-Talk, and in most cases they use the same basic command structure. All three trigger off Alt keys, and they all use dialing directories, as opposed to the individual parameter files used by older commercial programs like Crosstalk and MITE. Other common features are some form of script language, a split-screen mode for use with interactive "chat" systems, screen dumps to a text file, session logging, and, of course, uploading and downloading. They do all the normal telecommunications stuff, and in my informal testing, each one has performed file transfers flawlessly with a variety of protocols. Every one of the bunch has thorough documentation, though Pibterm's is the most extensive.

My favorite of the lot is ProComm. It has several features lacking in the others, including 11 types of terminal emulation (VT-100, VT52, IBM 3101, ANSI, ADM 3A, and so on), 19.2-kilobaud transfers, the ability to set a path and call your favorite editor while online, and a feature-rich host mode that essentially allows you to turn your system into a simple transfer-oriented bulletin board. On the down side, ProComm's script language is extremely cryptic and lacks branching conditionals, and you can set only 10 function keys.

Qmodem is a tiny bit easier to use, particularly for the novice, and its script language is much more like English (though to call any of these things "English-like" is a real stretch). However, Qmodem is missing the host mode, terminal emulation, and the Kermit protocol for transfers to/from bigger machines. You do get to set all 40 function keys for your macros, though.

Phil Burns wrote Pibterm in Turbo Pascal because he couldn't find a commercial package suited to the university environment in which he works. He confesses that if the other two had been around when he started the project, he wouldn't have bothered. Kermit, four terminals' worth of emulation, and a nice script language. And talk about macros—he not only gives you all four levels of function keys but three levels of keypad keys, for a total of 70. The program is simple and businesslike, and it lacks the exploding graphics and alarming sounds issued by ProComm and Qmodem. And because Burns has no desire to be a professional software developer, he gives you one big plus: source code. If you want to hack together your own routines, Pibterm is the ticket.

On the issue of support, Tom Smith and Bruce Barkelew are committed to turning ProComm into a serious business. They run a wide-open bulletin board, talk to you on the phone, take credit card orders, and in general have a nice attitude. Phil Burns threatens (pleasantly) that after one more revision—just one—he's going to stop work on Pibterm once and for all. So

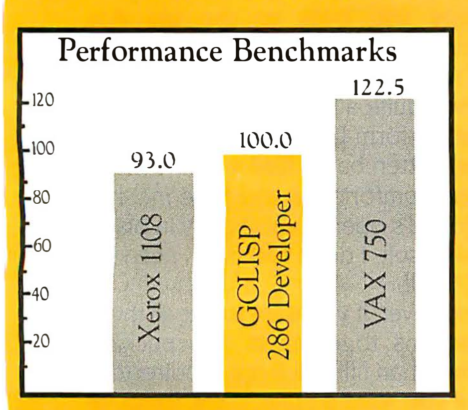
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*The results are found by taking the mean of the benchmark results from the performance and evaluation of LISP Systems by Richard P. Gabriel, normalized by the times of the GCLISP 286 Developer running on a COMPAQ Portable 286.

ITEMS DISCUSSED

INSTANT RECALL $69
Precept
3790 El Camino Real, Suite 173
Palo Alto, CA 94306
(415) 327-6886
Free version with 80K-byte database limit is available on bulletin boards and from users groups. A 2-megabyte version is available from Precept. Phone and mail orders are accepted.

PC-SHELL . . . . Free
Kent Williams
722 Rundell St.
Iowa City, IA 52240
Compiled program available on bulletin boards and from users groups. The author requests a $25 donation to help him buy his own computer system; in return, he'll send a copy of the compiled program and full C source code.

PIBTERM . . . . Free
Philip R. Burns
Source code and compiled program are available on bulletin boards and from users groups.

PROCOMM . . . . See below
PIL Software Systems
P.O. Box 1471
Columbia, MO 65205
ProComm support
BBS: (314) 449-9401
Voice phone: (314) 449-7012
The prices are $25 for registration, $10 for an evaluation or update disk, and $50 for registration, a disk, and a printed manual. Phone and mail orders are accepted. Missouri residents add 4.3 percent sales tax. Send a blank formatted disk and a stamped self-addressed mailer for a free copy of the program.

QMODEM $20
The Forbin Project Inc.
c/o John Friel III
715 Walnut St.
Cedar Falls, IA 50613
BBS: (319) 277-0044
Program available on bulletin boards and from users groups.

TSRCOM . . . . Free
TurboPower Software
478 West Hamilton Ave., #196
Campbell, CA 95008
(408) 378-3672
Send $5 (for materials and postage) to receive a disk with the software.

don't expect much hand-holding from him. John Friel III of Qmodem is somewhere in the middle. He runs a BBS, but it is only for registered users of his program. And his phone number is unlisted.

So, points go to Pibterm for source code. Points to Qmodem for ease of use. Points to ProComm for terminal emulation and attitude.

YOU WANT UNIX?

A few brief complimentary words about Kent Williams's PC-Shell. If you're aching to make your MS-DOS system look as much like a UNIX C shell as is reasonably possible, this one's for you. It's a memory-resident shell over DOS that gives you a wide range of UNIX-like commands, including fgrep, ls, touch, tee, y, pwd, cat, move, and so on. It keeps a command history that can be manipulated with all those wonderful UNIX commands that look like what passes for cursing in comic strips. It also will execute shell scripts from text files. DOS programs run under PC-Shell with few conflicts, and when you want to return to the DOS environment, typing exit drops you back to the old A> prompt.

Over the past few years, I've collected quite a few stand-alone utilities that perform UNIX-like functions, and I've written batch files with which I'm quite comfortable, so I have most of PC-Shell's operations already in place. As a result, I don't feel much need for PC-Shell.

However, if you want to get all those functions together in one package rather than filling a large subdirectory, or if you want a purer UNIX flavor, or if you want to train yourself or your coworkers to be familiar with the UNIX environment, you should check this one out. ■

Technological Breakthrough

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- *High Quality*
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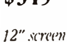
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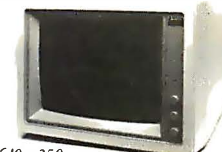
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- *FCC class 'B' approval*

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EGA MONITOR



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- *FCC class 'B' approval*

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- *Parallel port*
- *One Year Limited Warranty*
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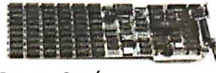
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- *Printer Port*
- *Monochrome Graphics*
- *Software Switchable*
- *Runs Lotus 123 Graphics*
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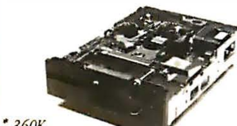
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- *128K Increment range*
- *2 serial port (1 option)*
- *Game port*
- *Self Installing software*
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- *Double density*
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Complies with FCC

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- *One Year Limited Warranty*

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- *Work with Auto Cad*
- *Mouse with DR. HALO*

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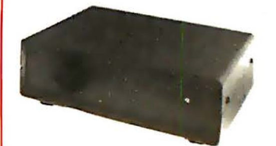


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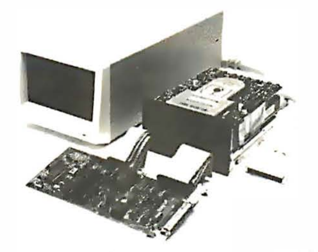


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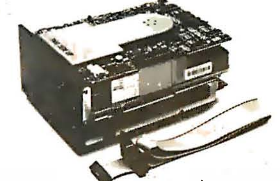
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FAST AT HARD DISK DRIVE



39 ms Access time

* 39 MS acces time
* Linear Voice Coil Activator
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* Auto Head Parking
* Cables, AT sliding rail and Software included
* One Year Limited Warranty

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40MB 4051	$699
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* One Year Limited Warranty

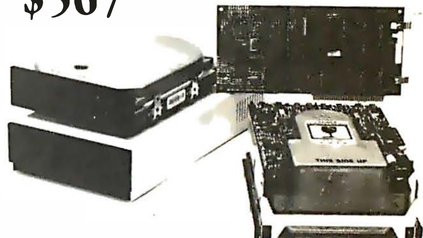
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For PC Upgrade to XT

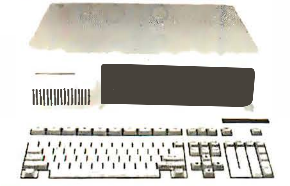
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* Floppy controller	$49
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* IBM Type Printer Cable	$15
* Split Power Y Cable	$8
* IBM AT Bus Extender Card (good for test & debug)	$30
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CHIPS

* EPROM 2764	$6
* EPROM 27128	$8

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	INTERNAL	EXTERNAL
* Teac	$580	$680
* Wangtek	$747	$827

SOFTWARE

* Communications BIT-COM	$49
* Graphics DR. HALO	$49

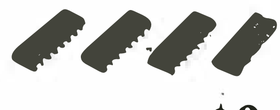
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* Kits for Mini I/O, 2nd Serial Port	$25
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* AT HD/Floppy Controller (XT size)	$160
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* AT keyboard	$50
* AT power supply 192 watt	$95
* Mini I/O	$45
* Memory short card	$40
* Two Drive Chassis	$85
* Math Coprocessor	CALL

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* W/ Power supply
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AT Hard disk/ Floppy controller



* AT compatible
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* XT Size Format

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TAIWAN'S COMPUTEX 1986

BY WILLIAM M. RAIKE

Taiwan can offer IBM work-alikes at prices that are quite low

Companies participating in the expanding Taiwanese computer industry had a chance to show off their latest developments at Computex, an annual show held in June at the newly completed Taipei World Trade Center. While the high-tech gathering convened inside the mammoth pyramidal air-conditioned complex of exhibition halls, glass-enclosed showrooms, and display booths, outdoors heavy rains were cooling down a sweltering city.

TAIWAN IS DIFFERENT

In previous columns I've pointed out two differences between personal computers in Japan and in the U.S. First, few machines sold in Japan are IBM-compatible; second, naturally enough, nearly all the computers you can buy have extensive Japanese-language processing features, which are not available outside Japan. Many visitors to Japanese computer shows are struck by the almost total absence of IBM-compatible computers. And except for peripheral equipment (disk drives, printers, etc.), Japanese personal computer manufacturers have not had any significant impact on the U.S. market for several years.

But Taiwan is different. With the domestic Taiwanese market for personal computers still small, manufacturers there have realized that they must compete in the U.S. and Europe. (In fact, most of the buyers at Computex this year were European; many U.S. buyers apparently prefer to wait for the Electronics Show held later in the year.) As a result, while you see a few systems that can handle the Chinese language, you will see a large number of IBM-compatible machines. Anyone traveling from the U.S. to visit a Taiwanese computer show would be well advised to bring along their favorite IBM PC and PC AT software for evaluating the computers on display. (Be sure that you leave backup copies at home though, and check with U.S. Customs on the way here to make sure that you can legally bring it out with you and take it back to the U.S unhindered.)

THE COMPETITIVE EDGE

The products and prices at this year's Computex gave me a reasonable indication of what U.S. computer buyers (and manufacturers) can expect within a few months. If you think prices on IBM PC and PC AT work-alikes have already dropped a lot, just wait. You can now order dozens of different makes of PC AT–compatible machines from Taiwan at prices ranging from $1150 to $1400. (Those prices are FOB Taiwan, excluding freight and insurance, and are for single units; all manufacturers offer substantial discounts for multiple-unit sales, and all are aggressive in their desire to do business, particularly in the OEM market.) Typically, these computers include 512K or 640K bytes of RAM and a single 1.2-megabyte floppy disk drive as standard equipment; you can get a 20-megabyte (or larger) internal hard disk drive for an extra $500 to $600.

Because space and time don't permit a detailed description of the many PC AT–compatible machines I saw at Computex, including some luggable semiportable computers, I refer you to the accompanying text box ("Some Manufacturers at Computex"). This representative list contains some of the manufacturers and their working IBM-compatible computers that were on display.

Comparable prices for Taiwanese IBM-compatible machines have dropped into the $500 to $600 range, and many manufacturers are offering an extensive selection of add-on and expansion boards. Despite the drawbacks of doing business with imported computers made by vendors with (in some cases but not all) a skeletal or nonexistent distribution and service network in the U.S., these prices will have a devastating effect on U.S. computer manufacturers. Remember the growing power and the plummeting prices of hand-held calculators during the mid-seventies? At this rate, we might see personal computers being given away as party favors before much longer. One way to appreciate the magnitude of the situation is to notice that, with some of the low-cost air fares that are available, it may well be less expensive to fly to Taiwan, buy a PC AT work-alike, and bring it back than it would be to write a check for the original.

Before you either buy a ticket to Taiwan or order a computer, though, be sure to check with the manufacturer to see that its computer meets all U.S. Federal Communications Commission standards for spurious electromagnetic emissions. At the time of the show, most of the manufacturers

(continued)

William M. Raike, who has a Ph.D. in applied mathematics from Northwestern University, went to Japan in 1980 looking for 64K-bit RAMs. He has been there ever since as a technical translator and a software developer. He can be contacted c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

SOME MANUFACTURERS AT COMPUTEX

AQUARIUS SYSTEMS INC.
6F. No. 394 Keelung Rd., Sec. 1
P.O. Box 43-29
Taipei, Taiwan, ROC

PC AT– and PC XT–compatible computers; both systems and main boards are available. The Model ASI-2003B is AT-compatible, with a 1.2-megabyte floppy disk drive, a 20-megabyte hard disk drive, and 512K bytes of RAM; it sells for $1841.

The Model ASI-703T is XT-compatible (4.77-/8-MHz switchable 8088-2 microprocessor), with 640K bytes of RAM and two 360K-byte floppy disk drives; sells for $689. It includes the ERSO BIOS.

AUTOCOMPUTER COMPANY LTD.
4F. No. 5, Alley 2, Lane Syh Wei, Chung Cheng Rd.
Hsin Tien, Taipei, Taiwan, ROC

A PC AT–compatible machine with 512K bytes of RAM, a 1.2-megabyte floppy disk drive, and a 20-megabyte hard disk drive sells for $1550.

A PC XT–compatible machine with 256K bytes of RAM and two 360K-byte floppy disk drives sells for $440. Both computers incorporate the Phoenix BIOS.

INTER-ORIENT AND WORLD CORPORATION
P.O. Box 48-243
Taipei, Taiwan, ROC

IMC brand PC AT– and PC XT–compatible computers: The Model GAT-403 is AT-compatible, with 512K bytes of RAM, a 1.2-megabyte floppy disk drive, and a 20-megabyte hard disk drive; it sells for $1640.

The Model IMC-1700E is PC XT–compatible, with 640K bytes of RAM and two 360K-byte floppy disk drives; it sells for $510.

The IMC Prince (Model JR-640) is a PC-compatible laptop, without a built-in display, running a 4.77-MHz 8088 microprocessor and with 640K bytes of RAM and a built-in 360K-byte floppy disk drive; it sells for $425.

K. S. BROTHERBOX COMPANY LTD.
No. 12 Chien Kuo S. Rd., Sec. 1
Taipei, Taiwan, ROC

Kingtech brand luggables. The Model KS-500A is a PC AT–compatible machine with 640K bytes of RAM, a 1.2-megabyte floppy disk drive, a 20-megabyte hard disk drive, and a monochrome/color graphics card; it sells for $1700.

The Model KS-200 is a PC XT–compatible machine with 640K bytes of RAM, two 360K-byte floppy disk drives, and a color graphics card; it sells for $750.

The Model KS-100B is a PC XT–compatible machine with 256K bytes of RAM, two floppy disk drives, and a monochrome graphics card; it sells for $480.

MICROWEB COMPANY LTD.
No. 9, Lane 146, Ta-Tung Rd., Sec. 1
Hsichih, Taipei Hsien, Taiwan, ROC

Touch-1 brand luggable PC AT and PC XT compatibles with built-in monochrome monitor and optional 10- or 20-megabyte hard disk drive. Prices not available.

MITAC INC.
9F, 585 Ming Sheng E. Rd.
Taipei, Taiwan, ROC

PC AT– and PC XT–compatible machines running the Phoenix BIOS. Mitac also introduced its Viso Portable, another laptop machine with no built-in display and one built-in 360K-byte floppy disk drive, with 512K bytes of RAM as standard. An external expansion box and an LCD are supposed to be available as optional items, but they couldn't be seen at the show. Mitac claims the Viso is FCC-approved. Price information was not available.

MULTITECH INDUSTRIAL CORPORATION
15F, 135 Chien Kuo N. Rd., Sec. 2
Taipei, Taiwan 10479, ROC

The Multitech MPF900 is an AT-compatible machine with a 1.2-megabyte floppy disk drive, an optional 20-megabyte hard disk drive, and 512K bytes of RAM. The company offers a variety of IBM PC– and PC XT–compatible computers and is one of the oldest and largest computer companies in Taiwan. Prices not available.

PLUS & PLUS COMPANY LTD.
2F, 126 Roosevelt Rd., Sec. 3
Taipei 10762, Taiwan, ROC

ARC brand PC AT– and PC XT–compatible computers: The ARC 286 Turbo System is AT-compatible and 6-/8-MHz switchable. It comes with 640K bytes of RAM, a 1.2-megabyte floppy disk drive, and a color graphics card and sells for $1190. The 20-megabyte hard disk option costs $390. MS-DOS 3.1 is a $35 option; a serial/parallel card costs $45 extra; an additional 384K bytes of RAM costs $45. A variety of other IBM PC– and PC XT–compatible systems are available.

said they were currently undergoing FCC approval; without this certification, you'll have trouble bringing a computer into the U.S.

ERSO UPDATE

Taiwanese personal computer makers found a way to handle the challenge of creating BIOS software that both gives their machines adequate compatibility with the IBM PC (or PC AT) yet manages to avoid copyright infringement problems (see my column in last December's BYTE). Some companies sign cooperative agreements with U.S. software houses to develop a proprietary BIOS; most companies, however, choose to use the ERSO BIOS. This was developed by the Taiwanese government-sponsored Electronics Research and Service Organization (ERSO, International Training Research Institution; No. 2, Alley 9, Lane 244; Roosevelt Rd., Sec. 3; Taipei, Taiwan, ROC) and is licensed by ERSO to Taiwanese manufacturers. I've heard a few complaints about the ERSO BIOS, notably that it is too slow. Nevertheless, it represents an innovative way for the Taiwanese gov-

The eight-line display, which has good readability, works as the main screen when you decide to use the Keystyle 80 as a laptop computer.

ernment to encourage and support its computer industry.

TAKE YOUR KEYBOARD ALONG

Like lots of people, I sometimes see a new product and wonder why I didn't come up with the idea myself. The latest one was the Keystyle 80, introduced at Computex by Chang Lei Electronic Industrial Company Ltd. (6th floor, No. 99, Fu Hsing N. Rd.; Taipei, Taiwan, ROC).

When connected by its cable to your computer, the Keystyle 80 works as a simple unintelligent keyboard. The Keystyle 80 has a built-in infrared coupler, so you can also use it as a replacement keyboard for the PCjr or for other PC-compatible computers that come equipped with such a coupler (the Sotec PHC-16 and the DataVue 25 are two examples). The keyboard layout, besides offering all IBM PC keyboard functions, is sensible and convenient enough that, in my opinion, it's suitable for serious word processing.

But you'll probably get a few strange looks when people wonder why your "keyboard" has an eight-line, 80-column LCD. The display, which has good readability, works as the main screen when you decide to use the Keystyle 80 as a laptop computer. Viewed as a portable computer powered by replaceable batteries, it uses a CMOS Z80A microprocessor running at 4 megahertz and comes with only 16K bytes of RAM as stan-

(continued)

dard, although you can expand the on-board RAM to 96K bytes. The weight of the unit, complete with batteries, is only 3 pounds.

The Keystyle 80 comes with a reasonable amount of utility software present in ROM, including a word processor (with commands that resemble those found in WordStar), calculator, world clock, and calendar. You also get a communication program in ROM. Since it manages the RS-232C serial port, you can use an RS-232C cable to connect the Keystyle 80 directly to a personal computer to upload files, to an external modem for communicating over the telephone, or to a serial printer to print files directly from the Keystyle 80 without going through another computer.

The Keystyle 80 should be available by this time; the people at the show were vague about pricing, but I would guess you could buy one for not much more than $300.

Computers and Coiffure

One of the most popular booths at Computex belonged to the Kingsbeam Electronics Corporation (No. 19, Lane 143, Jen Ai Rd., Sec. 3; Taipei, Taiwan, ROC). There was a steady line of women waiting to try out the Christine Hair Beauty Computer.

The prospective beauty shop customer can use the Christine to simulate what they would actually look like in a wide variety of hairstyles. As you sit in front of it for about 3 seconds, the video camera in the upper part focuses on your face. A computer in the bottom of the machine digitizes and freezes the image and displays it on a monochrome monitor facing you, housed just to the left of the camera. The operator can then step through a library of assorted hairstyles stored on a floppy disk by superimposing the image of each one over the customer's face on the display screen. The operator uses simple keyboard commands to move, expand, or shrink the size of the trial hairstyle to fit the actual size of the image of the customer's face. An optional video printer can produce a hard copy of any desired composite image (i.e., any customer and hairstyle combination) for the customer to keep.

The people at the show weren't able to demonstrate how the hairstyle templates are created and stored on the disk; presumably, an image of a model is stored and then edited graphically, but I couldn't ascertain the exact mechanism for doing this. The machine is supplied with a limited number of styles, and, as an extra-cost option, you can have new hairstyles delivered every three months. Sorry, the price was not available.

Next Month

Bill visits the Akihabara district of Tokyo, where vending machines sell information. There's good news for people seeking bilingual capabilities, and you can almost see the communications industry achieving a momentum of its own. ■

BASIC TO C

BY DICK POUNTAIN

An efficient way to translate Microsoft BASIC programs into C

Following the example of Andy Warhol, everyone should have a law named after themselves for 15 minutes. Here's mine: Pountain's law states that "the commercial importance of a programming language is inversely proportional to the amount of praise it receives." As evidence I offer you COBOL, a language for which no one can be found to say a good word, yet most of the world's commercial software is still written in it. And I'm told that the value of all the world's COBOL programs is greater than that of all the world's computer hardware put together.

Or take BASIC. It would be a rash journalist who spoke out too strongly in favor of the old war-horse nowadays, and academics have poured bile and scorn upon it for decades. Yet a huge amount of business software is still written in BASIC, both on minicomputers and micros. Why should this be so?

I think the reasons are several. First, BASIC is very easy to learn. I'm glad I learned to program in BASIC, hacking away on my own with a book; had I been taught Pascal at a university, I'm sure it would have robbed me of any pleasure in programming. All the things that conspire to make BASIC so unsuitable for large programs—lack of named subprograms with parameters, crude control and data structures, and even line numbers and GOTO—seem to accord with the way a beginner sees things inside a computer. I am less and less convinced by the arguments of innovators who insist, for example, that recursion comes more naturally to a beginner than iteration does. I'm also unconvinced by "reformed" dialects of BASIC; perhaps BASIC got it right the first time, but once you outgrow the language, you must discard it completely.

A second cause of BASIC's continued viability is a lack of alternatives. Most minicomputers and virtually all micros come with a free BASIC interpreter, often of venerable pedigree and relatively bug-free. In contrast, until the revolution wrought by Borland International (and pre-visioned by the prophet Leor Zolman, who wrote a high-quality C compiler that sold for $50 in 1980), compilers for more advanced languages like Pascal and C tended to be too expensive, poorly distributed and known only to hackers, or full of bugs. Some were all three. Small wonder then that so many programmers who needed to earn a crust rather than follow fashion just sat down and worked with what they were given.

A third reason is that BASIC actually does some things very well. For example, its string-handling features are immeasurably superior to those in C or Pascal (extended Pascal, that is) and indeed better than anything else except SNOBOL. Most business BASICs handle arithmetic on large cash sums gracefully, not always the case in other languages. By and large, BASIC makes no attempt to be portable but tends to support the hardware for which it was written as fully as possible, providing easy facilities for formatted hard copy, screen handling, and (maybe) graphics. BASIC's file I/O tends to be more powerful and easier to understand than that in a more rigorously portable language. Error handling in Microsoft BASIC is easy to use (and abuse!) and is highly suitable for commercial applications; on the other hand, I frequently encounter applications written in Pascal or C that crash with utterly obscure messages from the run-time system.

To salvage some shred of credibility, I should hastily add that I personally wouldn't write anything in BASIC nowadays, unless it were a three-liner to spot palindromes. My "road to Damascus" happened years ago when I spent three months writing a poker program in BASIC (the first program I wrote whose listing was taller than me) and found at the end that I couldn't understand how it worked. I came to appreciate the advantages of structured languages by trial and error rather than through moral imperatives, and as the years go by, I find that my admiration for Pascal more and more outweighs my irritation at its deficiencies. (Admittedly, I prefer Turbo Pascal, which a purist friend insists is not Pascal at all.)

This lengthy preamble is a way of introducing this month's subject, a translator for converting Microsoft BASIC programs into C. The rationale for the existence of the product, called CGEN, is that most of the United Kingdom's best-selling business programs (I'm talking here about accounting programs rather than spreadsheets) are written in BASIC, more precisely, Microsoft BASIC. However, the times are changing—the 68000 is upon us, and business software houses are faced with a growing base of multiuser UNIX systems. The idea of translating their existing

(continued)

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products into C, the language of UNIX, becomes attractive indeed. Such programs then become easily portable from one UNIX system to another and possibly even to newer personal computers like the Atari 1040ST.

Unfortunately, the vices of BASIC make such translation by hand an unpleasant prospect. In large BASIC programs, the overall program structure is unclear, thanks to the use of GOSUBs with line numbers instead of named procedures with parameters. The modularity of such BASIC programs can be poor, and it's not always possible to turn a BASIC subroutine into a corresponding C function. Conscientious design discipline and copious commenting help only marginally because the language itself does not enforce modularity. For instance, the use of global variables to pass values into subroutines means that such a subroutine can have effects, desired or otherwise, throughout the program, and only inspection of the whole program can reveal them. When you add the effects of the liberal use of GOTO to compensate for inadequate control structures (e.g., jumping out of FOR . . . NEXT loops), you have a recipe for a nervous breakdown.

Such translation is exactly the sort of nasty and boring job best left to a computer, and that is what CGEN does. It was written by MS Associates Ltd., a software house specializing in UNIX. As a result, the company has a deep knowledge of the foibles and limitations of C compilers, which was a prerequisite for making the product work.

THE CGEN APPROACH

Writing a translator that converts one language to another is not in itself newsworthy. To make such a translator effective and acceptable in commercial programming is another matter.

Program generators and so-called fourth-generation languages attempt a similar trick, although they usually translate a very high level specification language into BASIC or COBOL. One problem that often bedevils such products is the maintainability of the output code. Computers may be patient, but as yet they are not very smart, and the quality of the code they write can be pretty rough, even by modest human standards. I once inspected the BASIC output from a much-touted program generator and found that the code was not only unreadable but barely recognizable as BASIC.

MS Associates chose to tackle this problem by reducing the "distance" between the source language and the target language. CGEN produces as its output an intermediate language called High-C that looks more like BASIC than C, although it is in fact C and can be compiled with a standard C compiler. High-C is a collection of macros for the C preprocessor that are designed to be similar to BASIC keywords.

This technique is not new. Indeed, many experimental languages in computer science departments started out as a set of C macros on a UNIX system. The C preprocessor is a powerful piece of software, whose potential is barely tapped by most programs. For example, a C programmer typically sets up named constants for use in a program with #define, as in

```
#define ESC 27
```

Before compilation, the preprocessor goes through the program and replaces every occurrence of the string ESC by the number 27. However, #define can do more than this. Because macros can take parameters and include conditional expressions, they can be used to change the syntax of the language. For example, to add a "function" to compute the maximum of two numbers, you could say

```
#define max(num1,num2) ((num1) >
   (num2) ? (num1) : (num2))
```

Whenever max is used in a program, the preprocessor will replace it with the conditional expression on the right. The result is more efficient than a proper function definition since it compiles to in-line code with none of the overhead of a function call. It does, however, increase the compiled code size.

The advantages of the High-C approach are twofold. First, it simplifies the task of translation by taking work away from the translator and putting more of it onto the C compiler. Second, the output is readable and maintainable by programmers who are accustomed only to BASIC. After some experience with CGEN, BASIC programmers should be able to write directly in High-C and to modify High-C programs without retranslation. This is by no means a trivial advantage because the cost of retraining programmers to become expert in C is considerable. You do need to know the fundamentals of C to use CGEN, but you don't need to be a guru.

The downside is that the final code is somewhat larger and less efficient than the code a more "C-oriented" approach might produce (although most business programs are far from time-critical anyway). C compilation also takes longer, but, on the other hand, translation is correspondingly quicker.

THE FINE POINTS

Before we take a look at an example of High-C, it would be wise to establish just what CGEN can and cannot translate. It is designed to translate software written in various versions of Microsoft BASIC and can handle programs that use CHAIN to exceed the 64K-byte limit. It will not translate hardware-specific commands, like those used for graphics, sound, and color. A program written in BASICA for the IBM PC, for example, must have any references to commands like COLOR or PSET removed before translation. Fortunately, much business software is written using only simple cursor-addressable terminal output, and CGEN does support LOCATE.

Since High-C gets compiled to native code, none of the facilities specific to interpreted BASIC can be used. For example, it is not possible to use ERASE to remove arrays from

COMPANY MENTIONED

MS Associates Ltd.
St. Marks House
1 Station Rd.
Bourne End
Buckinghamshire SL8 5QF, U.K.

Listing 1: *This sample code shows the Sieve of Eratosthenes translated into High-C by CGEN.*

```
#define NOERROR
#define DEFS
#include <msmain.h>
#undef DEFS

int      iCOUNT ;
int      iI ;
int      iK ;
int      iM ;
int      iPRIME ;
int      jFLAGS [8191+1] ;

char *_data[] = {
NULL, "99999999",
NULL, NULL
} ;

main( argc , argv )
int  argc ;
char *argv[] ;
{
#include <msinits.h>

L10:;
L20:;
L30:;
        LSTART ;
        PSTR( "10 iterations" ) ;
        PRINT ;
L40:;
        FOR1i( iM , 1 , 10 )
        {
L50:;
                iCOUNT =  0 ;
L60:;
                FOR1i( iI , 0 , 8190 )
                {
L70:;
                        jFLAGS[iI] =  1 ;
L80:;
                }
                NEXT ;
L90:;
                FOR1i( iI , 0 , 8190 )
                {
L100:;
                        IF ( jFLAGS[iI] == 0 )
                        {
                           GOTO L180 ;
                        }
L110:;
                        iPRIME =  iI + iI + 3 ;
L120:;
                        iK =  iI + iPRIME ;
L130:;
                        WHILE( iK <= 8190 )
                        {
L140:;
                           jFLAGS[iK] =  0 ;
L150:;
                           iK =  iK + iPRIME ;
L160:;
                        }
L170:;
                        iCOUNT =  iCOUNT + 1 ;
L180:;
                }
                NEXT ;
L190:;
        }
        NEXT ;
L200:;
        LSTART ;
        PINT( iCOUNT ) ;
        PSEP(',') ;
        PSTR( "primes" ) ;
        PRINT ;
L210:;
        END ;

        FINISH ;
}
```

a program at run time. This limitation is usually not a problem because few—if any—business programs are interpreted; they are normally compiled with a BASIC compiler like BASCOM or QuickBASIC that imposes exactly the same restrictions. In general, CGEN will translate anything that compiled (not interpreted) BASIC would accept.

Porting from PC-DOS or MS-DOS to UNIX can raise problems due to the different way that UNIX does some things (although such problems would have to be faced however you do the translation). UNIX uses only a linefeed to end lines, for example, whereas PC-DOS needs a carriage return plus a linefeed; CGEN, though, can handle this difference automatically. In another case, UNIX has a different convention for filenames, which is sensitive to uppercase or lowercase, and these details will have to be altered manually, either in the BASIC source code or in the High-C code.

One or two actual syntactic restrictions apply with CGEN. It will not tolerate the use of NEXT in a conditional, as in

```
10 FOR i = 0 to 100
20 IF array1(i) = array2(i) THEN
   NEXT
30 PRINT i
```

For CGEN to work, this needs to be changed to

```
10 FOR i = 0 to 100
20 IF array1(i) <> array2(i) THEN
   value = i : i = 100
30 NEXT
40 PRINT value
```

Similarly, there are restrictions on the use of GOTO to exit early from FOR. . .NEXT loops. GOTOs must either be removed or be patched in the translated High-C version by adding a special LEAVE macro before each GOTO to keep the stack under control. PEEK and POKE are supported, although, of course, you cannot expect hardware-specific PEEKs and POKEs to work if moved to a new machine. They can be put, however, into an IF. . .THEN to allow conditional compilation of machine-specific versions of a program.

(continued)

CGEN also adds some extra facilities to Microsoft BASIC. In particular, for file and record locking for multi-user applications, the LOCK command can be inserted into the original BASIC program. Another extra command is $DEFSUB, which tells CGEN that the following subroutine is independent enough to be turned into a single C function; for example,

```
10 ' $DEFSUB 'getname 30-50'
20 GOTO 60
30 PRINT "Enter your name: ";
40 LINE INPUT NAME$
50 RETURN
60 GOSUB 30
70 PRINT "Hello "; NAME$
```

The $DEFSUB command says that the code on lines 30 to 50 will be translated to a single C function called getname. This is an optimization technique and is not compulsory.

USING CGEN

I tried a new version of CGEN for the IBM PC running under PC-DOS (all previous versions have been for different flavors of UNIX). It's not a large system; the whole thing fits onto a single IBM floppy disk with all its include files and the run-time library. It's not copy-protected and can be installed on a hard disk. It supports some IBM special features like the function keys but, as previously mentioned, does not support graphics, color, or sound.

CGEN itself is a single program that takes just the name of a BASIC program file as its command-line input. The BASIC source code must be in ASCII rather than in tokenized form (i.e., it must have been saved with the A option). When CGEN has been run over a file, it produces two output files with the extensions .LST and .C, the latter containing the High-C version of the source code.

The .LST file contains the original BASIC source program with messages from CGEN inserted, prefixed by *** for errors and +++ for warnings. These messages are in plain English, and the warnings cover most potentially troublesome constructions (e.g., jumping out of a subroutine with GOTO or subroutines with multiple entry points). CGEN can thus be used as an analyzer prior to translation. There are a number of command-line options, most of which have to do with the limitations of various C compilers, like limits on the size of functions, the number of symbols, or the length of jumps.

I tried CGEN on the sample program (MORTGAGE.BAS) that IBM supplies on the PC-DOS master disks, and CGEN correctly picked up all the COLOR statements as untranslatable. I then used the search-and-replace command of my word processor to edit the source program, searching for *** or +++. MORTGAGE.BAS translated cleanly after I removed all the COLOR and WIDTH statements, and MORTGAGE.C compiled and ran correctly with the Microsoft C compiler.

There isn't room here to show the complete translation of MORTGAGE.BAS, but listing 1 shows our old favorite, the Sieve of Eratosthenes, translated into High-C by CGEN. The translation is a bit more verbose than the original due to the declarations needed by C, but the main part of the program corresponds quite closely. The C labels L10 to L210 replace the BASIC line numbers. The High-C macro LSTART stands for list start and gets inserted wherever BASIC permits an arbitrary-length list of parameters, as in PRINT statements.

The way FOR. . . NEXT gets translated provides an interesting example of the problems that BASIC can pose. FOR. . . NEXT in Microsoft BASIC permits several unsavory practices, like assigning to the index and even to the loop limit at run time. Routine testing for the use of such rarely employed tricks is too expensive, so MS Associates set up 18 different FOR macros: six base types for each of three different degrees of "dirtiness." The six BASIC variants include FORi (integer index, step <> 1), FORn (float index, step <> 1), and FORd (double-precision index, step <> 1); rounding out the six are the equivalents FOR1i, FOR1n, and FOR1d with a step of 1. CGEN automatically produces the right type—FOR1i in the case of the Sieve—but for BASIC programs that use the dirty tricks, you must manually select a "dirtier" set of FOR macros. The macro expansion for the "cleanest" version of FOR1i is

```
#define FOR1i(A,B,C) for( A=I(B) ;
  A<=(C) ; A++)
```

CGEN took 6 seconds to translate the BASICA Sieve into High-C; table 1 shows the times for compiling, linking, and running the Sieve in High-C. Unfortunately, I didn't have BASCOM available, but I accept the assurance of MS Associates that programs run marginally faster with CGEN than if compiled with BASCOM. CGEN is thus a portability aid rather than a performance booster.

You can, of course, add raw C code at will into the High-C version of a program as an alternative to calling routines written in C (or other languages, including assembly language) from the BASIC version.

MS Associates started out by selling CGEN at a high price to other software houses that needed to translate established BASIC products. However, the company has now reduced the MS-DOS version to a more PC-like price of £345. For an extra fee, the run-time library is available in source as well as binary form so that you can tailor High-C to particular target machines. ■

Table 1: *Times required (in seconds) for compiling, linking, and running the Sieve of Eratosthenes in High-C versus Microsoft C on an IBM PC AT.*

	Compile	Link	Run
High-C	14	15	4
Microsoft C (version 3.0)	5.5	4	2.5

Inquiry 339

C·H·A·O·S M·A·N·O·R M·A·I·L

Conducted by Jerry Pournelle

Scientific Graphing Software

Dear Jerry,

By now you should have received a copy of my program Graph-PAD (Graph Plotter and Digitizer) from Academic Press. I am writing this letter in hopes of convincing you to take a look at this unique program, which enables scientists to create publishable graphs using an IBM PC and an HP plotter.

You have suggested on a number of occasions that software should be sold by publishers. Academic Press is a scientific book publisher that is new to software. As you might expect, there are advantages and disadvantages publishing software through a company whose main business is not software, but it is a trend you ought to write about.

You should be pleased by the lack of a licensing agreement. Graph-PAD is sold like a book and protected by copyright. No silly agreements. You should also be pleased by the manual, which is typeset and includes an index and several examples (probably not enough).

You will be less pleased by the copy protection, so let me explain. Over the years I have agreed with your arguments against copy protection and I originally asked that AP not protect Graph-PAD. But then I realized that, although businesses are quite responsible about respecting copyrights, scientists are not. The potential market for Graph-PAD is not huge and illegal copies would dilute the market too far.

Graph-PAD is protected by the key-disk scheme but with a unique twist. You cannot use the plotter to make a graph until you insert the key disk into the A: drive. However, you can enter, average, transform, and preview data on the screen and save it to disk without the use of the key disk. Thus, you can use a copy for entering and manipulating data but must use an original Graph-PAD disk to actually make graphs. A backup disk is provided.

HARVEY MOTULSKY
San Diego, CA

I fear your program has become separated from your letter. That happens more often than not. Alas, there's no generic solution to the problem other than to increase the staff here, and I don't want to do that. The result is that a lot of good stuff vanishes. With any luck it will emerge again, but since I don't have an HP plotter, there's not much I can do with it anyway.

I do think that the era of single-product publishers is coming to an end. I've been saying that for a couple of years, which is a long time in this industry but not very long in any other.

You may be right about copy protection on a program but I think that if I were betting my academic publications on a program, I wouldn't use one I couldn't back up. You may be protecting yourself from market dilution but any good hacker could defeat your copy protection. The other question is what effect copy protection will have on sales.

Good luck.—Jerry

DRI Service

Dear Jerry,

Regarding Digital Research Inc. By golly, I think they might be listening! I recently bought a copy of GEM Desktop and GEM Draw and found the documentation to be quite readable and complete (not a single d:ufn.ext in the thing). It turned out not to work as advertised, however, due to missing device drivers on the master disk.

As is typical of most of the local software dealers when confronted with anything less ordinary than WordStar, mine shrugged and grunted when I asked after the missing drivers but was able to offer no assistance.

Well, in for a dime, in for a dollar, thinks I. So I called DRI's customer service number, expecting the worst. The fellow I spoke with was polite, but when I told him which version I had bought, he said, "Oh, well, that explains it. I don't know anything about that version and I don't intend to learn now." I figured I was about to hear how DRI didn't support *that* version any longer, and I would have to buy the new version, etc.

Wrong! This kind soul, representative of what I hope is the new Digital Research, said I would have to wait while he mailed me a copy of the new version of GEM, which he would do within a week or so. No mention of money was made at this or any time since. As it turned out, I got the new copy as fast as UPS was able to carry it here from the West Coast, meaning he must have sent it out that afternoon. Now all is well.

You'll have to admit that this is assuredly *not* the kind of thing one has come to expect from DRI, but it is a trend much to be admired and encouraged.

I've long enjoyed, and generally agreed with, your (to put it mildly) taking DRI to task for their failings. Now it appears that they read BYTE. Good show!

STEVE RINDSBERG
Cincinnati, OH

Thanks for telling me. DRI still has some great potential. There was a time when I was certain that Concurrent CP/M, which can already run most MS-DOS programs as one of its tasks, would be expanded to be more MS-DOS–compatible, then, combined with GEM, have something like UNIX brought in to make an operating system that would be simple for users and have, invisibly, a rich programmer's environment. The result would be the reunification of much of the micro community.

That's still possible and I'm still hoping, even if I'm no longer so confident.—Jerry

License Agreements

Dear Jerry,

In your book *Adventures in Microland*, you claim in Chapter Five that "Software publishers sure are arrogant. Fortunately, that's going to change." I would have to add, "Unfortunately, not anytime soon."

The other day I picked up *Webster's New World Spelling Checker* for my Apple IIe. It's published by Simon & Schuster, the same folks who distribute your book. It's a really super program: the documentation is first rate (it includes a *Writer's Guide to Punctuation and Manuscript Preparation*), the price tag is low (only $59.95), and the disks are non-copy-protected. It works on a wide variety of word processors and features a 114,000-word dictionary. I couldn't ask for more.

Except for a less restrictive license agreement. It claims that, as the authorized user of this product, I can ". . . use

(continued)

the Licensed Product on any single computer system. A separate license . . . is required for any other computer system on which [I] intend to use the Licensed Product." Furthermore, I ". . . shall take all reasonable steps to safeguard the Licensed Product and to ensure that no unauthorized person shall have access to it . . ." And then, in big black letters, I ". . . may not use, transfer, modify, copy or otherwise reproduce the Licensed Product, or any part of it, except as expressly permitted in this End User License Agreement."

Now, say I want to demonstrate this program at my local Apple users group. Does S & S seriously believe I'm going to drag my desk-bound system, with all its attendant cables and peripherals, to the meeting place, and, once I've shown off Webster's features, to disallow other members a hands-on demonstration of their own? What if I bring only the main computer unit and I plug in somebody else's printer and monitor? And what about making more than one backup of the program?

Because of all the accesses required, a spelling checker's floppy is an especially fragile beast; I'm no pirate, but if my first backup wears out and I make another, will I be subject to criminal prosecution? Since I signed their Warranty Registration Card, I suppose so.

Experienced publishers like S & S have been able to live with simple copyright notices and the usual "All rights reserved including the right of reproduction in whole or in part in any form" statement for their books; why should their software be any different? If S & S isn't going to change, why should anybody else?

Don Drews
Milwaukee, WI

I have nothing to do with S & S Software but apparently they let their lawyers talk them into this nonsense. As you say, they've understood about books for a long time. Why this? Beats me.

I particularly enjoy the part in which you must promise that "no unauthorized person shall have access to" their program. Are my wife and children "authorized"? For that matter, am I? And, of course, they don't promise that the program will indeed work.

Yours isn't the only letter complaining about them; I expect they'll be candidates for my Folly of the Year award next year.—Jerry

Modula-2 Help

Dear Jerry,

I am very interested in learning more about Modula-2 as a programming language. From your articles, you seem to be very favorable to the potential of this language for the future. The problem is that there seem to be very few books on the subject (at least in Toronto).

Could you please suggest a couple of books to me, taking into account the fact that I do not know Pascal. Also, do you know if there are any public domain programs in the language that will operate on PC- or MS-DOS? (I have a PCjr with 256K bytes of memory.)

Ron Golan
Willowdale, Ontario, Canada

The best book is one I haven't written yet; I have about a million example programs and modules done, but it's taking time to do the text. Until my own book comes out, the best introduction to Modula for non-Pascal people is Edward J. Joyce's Modula-2: Seafarer Manual

(continued)

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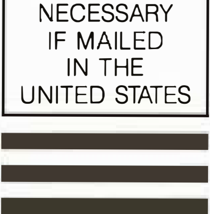
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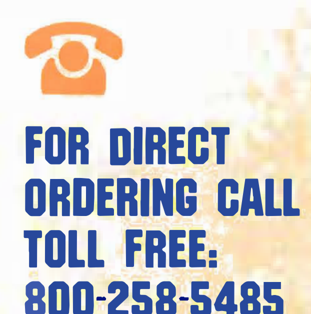


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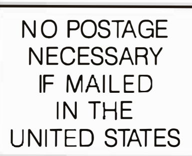
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(Addison-Wesley, 1985). It doesn't cover everything, but it starts at a low level and there are good examples. Pournelle's law: You can't have too many examples. This book hasn't as many as I'd like, but it has more than most.

After you finish with that book, get Software Development with Modula-2, *by Gary Ford and Richard Wiener (Wiley, 1985); it's about the best "full feature" book on Modula that I know of—better than anything I could write—but it's not for beginners.*

Unless you really know what you're doing and/or your time is worth literally nothing, public domain compilers aren't worth your effort. You'll do better to get a good commercial one. Logitech sells an excellent MS-DOS Modula-2 compiler for under $100. Workman and Associates has FTL Modula-2 for CP/M, also under $100. Both programs come with their own editors and are excellent.—Jerry

ON THE ONE HAND . . .

Dear Jerry,

As a result of your enthusiastic recommendation, I recently purchased WRITE. I am impressed by its printing capabilities. For variety of page format, ease of use, and right margin justification, it gets high marks.

I would have been more impressed by WRITE as a text editor if I had not already used Express 2.0. In my judgment, Express is a truly transparent medium. Like WRITE, it can be reconfigured so you don't have to learn a set of new and arbitrary commands. Entering text is easy; moving around in the text is easy; correcting errors is easy.

Like WRITE, Express works in memory, but it can edit files that are much larger than its buffer. Its search and replace goes like greased lightning because, unlike WRITE, it does not rewrite the screen until the whole process is over. It has a one-command block move and both block-read and block-write capability. Best of all, its capacity for creating macros is practically unlimited. And all this for $35!

What you don't get is the kind of printer driver that WRITE supplies. Express 2.0 uses Roff4, a public domain program that does a good job of running the printer but lacks the ease and versatility of WRITE's print program.

WRITE will print Express 2.0 files, but if you want right margin justification you have to strip the carriage returns that Express puts at the end of every line. Express could strip them in no time, but it can't see them; WRITE can see them but it takes forever to strip them off. If, among all those programs you have tried, there is one that edits as well as Express 2.0 and prints as well as WRITE, it must be the jewel of CP/M word processors.

THOMAS WHEELER
Knoxville, TN

I've written for a copy of Express. Of course, I'm also trying to change over from CP/M. So far I haven't been weaned away. Incidentally, with WRITE you get a filter program that ought to strip off those hard carriage returns; and for that matter it's fairly easy to write such a program for yourself in BASIC.

I'll let you know about Express when I get it.—Jerry

COMPUTER CONFERENCING

Dear Jerry,

I am a 36-year-old research student currently studying for a masters of philoso-

(continued)

phy degree in Information Systems. My thesis is on the design of methodology. I also have a personal research interest in computer conferencing and industrial democracy. My original degree was in English and Social Policy.

I am perhaps not as technically focused as many of the current BIX users appear to be, based on the Best of BIX pages. Further, I am an Acorn/BBC user and find little of interest in discussion of the machines that are more prevalent on your side of the "pond." In the April BYTE in "Winding Down" (page 299), you mention setting up a conference/organization dealing with the synergistic effects of the new cognitive sciences. This sounds more interesting to me than the other reproduced content of BIX and it could be a deciding factor in choosing to subscribe. I wonder if you would be so kind as to forward fuller details?

S. A. Allen
Portsmouth, Hampshire, U.K.

Well, we have a conference on BIX on cognition and social science theory. It supports the CONTACT conferences, which are interdisciplinary meetings that get science fiction, social science, and hard science professionals together.

For more information on that, write Mrs. B.J.O. Trimble, 696 South Bronson, Los Angeles, CA 90005.—Jerry

CBASIC: Another Voice from the Wilderness

Dear Jerry,

I thought it a curious coincidence that the May BYTE contained two perspectives on BASIC as a programming language.

In the Letters section, Chuck Musciano ("Choose Your Language," page 14) wrote that he personally found BASIC "distasteful" and that BASIC "only suffices when a quick hack is required." Mr. Musciano obviously writes from the Olympian heights of the "professional programmer," where CBASIC is an unknown dialect. I think that Mr. Musciano understands neither what BASIC is supposed to do nor for whom it is intended.

When I got to the opposite end of BYTE, I was pleased—even gratified—to see in Chaos Manor Mail the letter from Paul Palmer ("CBASIC," page 392).

I sympathize with Mr. Palmer. I feel his isolation but suspect it is self-imposed. I am sure there are a number of CB80/86 users out there, all busy writing their own unique applications. Do we not talk to each other because we believe our problems are unique?

In that regard, I am not particularly sympathetic to Mr. Palmer when he complains about being constrained to 128K bytes of code and data. He should try writing code when 48K is all that is available! With 48K, you chain like crazy and become a master at disk I/O. My advice to Mr. Palmer is to write more efficient code and don't be reluctant to use disk storage for data.

Harold Horn
Argo, IL

Well, Computing at Chaos Manor began as "The User's Column" and that's the way I still think of it. I like Modula-2 a lot, but I confess that for most computer applications I still use BASIC.

Let me hasten to add, though, that I don't do much programming any more. If I did, I'd concentrate on Modula-2, building myself a battery of applications tools I could incorporate into nearly any program. Of course, you can do that with CBASIC, too (indeed, one reason I stay

with CBASIC is that I have such a lot of known-to-work code).

I remember 48K systems. I remember 16K systems. I also have nightmares sometimes.—Jerry

THE NEED FOR SPEED

Dear Jerry,

I can no longer stand to feed single sheets into my printer. I have to buy large boxes of paper. So what? you ask. The point is, since I have been using a computer, my general sense of time is completely different (no small matter).

There was a time when I could do things like wait for a bus. Now I am furious over a program that takes 8 seconds to load. There was a time when I could do things like wait for a big one to bite the hook. Forget it. I used to hate benchmark talk. Who in the real world of men cares about nanoseconds? Now I am very curious about how fast the computer does things.

When you get right down to it, the only thing a computer can do is shuffle numbers back and forth. But (and this is a big but) it can do it incredibly fast. That's what makes computing so fascinating. One word: speed. So I no longer have any patience with anything. I want it done now. Jerry, I may never be able to kill another sunlit afternoon in the middle of a lake wetting my line.

MICHAEL SONTUM
Sandy, UT

You're so right. I find myself reading faster (1200 baud now) and very impatient with things that don't go as fast as my computer. However, I also find that as soon as I get on a backpack and get away from the trailhead I leave all that behind.

After all, they're only machines, although I don't want mine to know that I know that.—Jerry

MAC SCREEN SIZE

Dear Jerry,

I read with interest your negative comments on the Macintosh screen and letter size in the May issue of BYTE. There are several desk accessories that allow you to change the default font from 9-point Geneva to, say, 12-point Chicago. This usually gives letters that are large enough for most people to see even if they are very visually handicapped.

I am lucky enough to have the use of both a Mac Plus and an IBM PC XT and I can assure you that the Macintosh is leaps and bounds ahead of the IBM in anything I have yet needed to do, including reports and strategic planning documents. (Not to mention the superiority of Excel over Lotus 1-2-3.)

D. SCHAFFELBURG, M.D.
Montreal, Quebec, Canada

Of course you can make the letters larger, but then you don't get so many on the screen. Clearly, I can live with a few lines of not too much text—on airplanes, I do all my writing on the NEC PC-8201, which, even with Traveling Software's Ultimate ROM II, has only 8 lines of 60 characters each. But when I'm home with a desktop machine I prefer something a little better. I've also yet to find a Macintosh text-editing program that comes close to what I'm used to.

Having said all that, I agree: Now that Apple is market-driven rather than guru-driven, the Macintosh is a pretty good entry-level machine, and I'm already on record as saying it's almost worth buying a Mac just to have Excel.—Jerry ■



BIX is the BYTE Information Exchange, BYTE's computer conferencing system. Each month, Best of BIX brings you excerpts from a few of the 170-plus conferences active on BIX. This month, conferences covered include Amiga, Atari ST, IBM, Macintosh, and S-100.

For information on joining BIX, see the instructions on page 271.

AMIGA

The Amiga section examines three problems: First, a discussion of the concerns inherent in writing software for a multitasking environment evolves into a search for the optimum "Animator" priority setting. Next, a father forwards his son's query on using the Amiga to time millisecond events in a laboratory setting. Finally, there is a look into the deeper meaning of REVPATH as an Amiga is pressed into service as a speaker's prompting device.

MULTITASKING ON THE AMIGA

amiga/main #3406, from lnoland (Les Noland)
a comment to message 3363

[Ed. Note: Message 3363 discussed, among other topics, the difficulties of porting to a multitasking system.]

It seems to me that there are a number of things that can make porting single-tasking programs to a multitasking environment difficult.

To begin with, a number of practices that are perfectly acceptable in a single-tasking system are unacceptable or ill-advised in a multitasking system. For example: polling input devices; assuming all resources are dedicated (e.g., printing a line of output at the beginning of a program and then not doing any more printing until much later in the program); or creating large static arrays that are infrequently used.

Then there are all the system calls that are inherent in multitasking but unknown (or generally unnecessary) in a single-tasking system, such as process (and task) priority scheduling and memory allocation routines.

To be sure, one can make ports easier by creating some standard routines that handle most of these situations in a default manner (such as always spooling printer output for later printing). Handling the situation like this, however, will frequently result in routines that are far from optimal and could have a hard time competing with other tasks. For example, some routines could benefit from continuing to process data while waiting on disk accesses. Others have no choice but to perform a hard wait. If the designer doesn't consider these choices, the best decision can't be made so the safe choice (in this case, the hard wait) becomes the only choice. Another example is the "deadly embrace" situation. If one relies on prewritten I/O routines to perform the resource allocation, the process won't even likely be able to recognize a "deadly embrace," let alone choose the optimal course of action.

While you're quite correct in saying that a lot of programs represent a straightforward port and that going in the other direction is no bed of roses either, I believe that, in general, for a program to do well in a multitasking system, it needs to be designed for one, and that can mean substantial changes for some single-tasking programs. Obviously, some people aren't up to the challenge because there seem to be far too many programs that just grab all the resources first thing and act like they are the only programs in the system (which they probably will be, given the fact that they won't run with most other programs anyway).

---

amiga/main #3410, from jim_kent (Jim Kent)
a comment to message 3406

Well, I hadn't thought of most of those. I guess I've been trained now for multitasking. I even do sleep calls on the ST, though my sleep routine just polls the clock, of course. Did you know GEM on the ST MAKES you poll input if you want the right button on the mouse? Yelch!

Still, I have to admit single tasking is nicer for animation. Things run much less jerkily. The Amiga keeps waking up a process to check the disks even when nothing but the Animator is running. Well, I think it does. Something makes me jerk every couple of seconds.

---

amiga/main #3416, from w.volkaegls (William Volk)
a comment to message 3410

Jim, how about a priority slider in Animator? (I know it's a warped idea.)

---

amiga/main #3418, from jim_kent
a comment to message 3416

Can you change a task's priority on the fly?

---

amiga/main #3419, from skrenek (Steve Krenek)
a comment to message 3418

Sure, SetTaskPri (task, priority) and away you go! If your task is really a process, I'm not sure what you do to change the priority, though.

---

amiga/main #3420, from w.volkaegls
a comment to message 3418

Don't know ... we could make it a CLI argument.

---

amiga/main #3422, from jgoodnow (Jim Goodnow)
a comment to message 3419

As far as priorities go, the actual scheduling doesn't know anything about processes, only tasks. So changing the task's priority changes the process priority.

---

amiga/main #3426, from lnoland
a comment to message 3410

Sleep calls on the ST, eh? Boy, when the ST goes multitasking, are you ever going to be ahead of the competition! Of course, if GEM pulls many tricks like the mouse polling bit, it may be a while before they get any reasonable multitasking implemented (unless they just abandon their installed base of software ... not likely).

Though time-sensitive programs like Animation could pick up some fallout from other tasks, it seems to me (Les - be careful here! Remember the Basic Library fiasco. You don't have the RKM's yet - you don't know what's going on with the Amiga internals.... I know that, but how radical could it be? All multitasking systems are pretty much alike, aren't they? Shhh! Wait a minute - it's too quiet in here. Hey, what are all you people doing listening in on my internal dialogue?) that on an open machine with all DMA I/O, the only overhead you should have is the short trip to the scheduler when your time quantum runs out and that should just dump you right back in. Do you have Workbench running? Have you set a nice, high, antisocial priority so as to discourage all other tasks? Hmmm...

---

amiga/main #3428, from lnoland
a comment to message 3416

Somewhere in this conference, many messages ago, someone (tking?) asked for suggestions on things we'd like to see in V1.2. I wish I'd had the presence of mind then to suggest a utility that displays all tasks (including Workbench tasks) and their priorities and allows one to modify the priority of any task. A

pretty standard item on mainframes and such, I was a little surprised that the Amiga didn't have it. Perhaps it'll be one of the first things I'll work on after I get and read the RKM's (and get a little more spare time to spend on home projects).

amiga/main #3431, from jim_kent
a comment to message 3426

No, I'm very social. I've got a priority of 0. Maybe I'll change that during the actual replay to 1 or 2. Intuition has 10, and I can't go as high as that or I'll lose my input.

But I'm not sure if I should even do this. For instance, if SoundScape adopted the same attitude, then we couldn't run together effectively. (We can't anyway unless you've got expansion RAM, but still...)

amiga/main #3503, from lnoland
a comment to message 3431

Re the priority of your animations. Only the animation itself need have a higher priority. Your input and setup tasks can run at the lower priority.

Since your animation task has to wait on things like vertical retrace and such, there are likely enough waiting times to allow other tasks to run, though in degraded mode. As for running in harmony with other tasks, the point is that with certain types of tasks, such as animation and music, it is desirable to have the task run in "real time," as if it is the only thing running on the machine. To do less sacrifices the "realism" you are attempting to create. If the user attempts to run other tasks at the same time, he should expect them to run in degraded mode for the sake of retaining the realism of the animation.

If he is attempting to run something else that also requires real-time response, he may be asking too much of the system - two tasks cannot run on a single CPU without some degradation in performance unless both use less than 50% of the CPU's time and their operation is flexible with regard to when their time slices fall. This may be true of your routine but it wouldn't seem likely if you were able to notice the delays in the animation. You're the one who has to decide if a higher priority is necessary and what that priority should be, but from what you've said, it sounds like it may be necessary. Ideally, the user would be able to change the priorities of different tasks on the fly, setting them to meet his own requirements. Most mainframe systems have a utility for this purpose, but this system does not, which leaves them stuck with what the developers deemed necessary.

amiga/main #3517, from jim_kent
a comment to message 3503

Well, I've been looking into the priority/smoothness thing a little. What set me off thinking was watching animations side by side on the ST and the Amiga. (Since the script files are text, it is easy to get them between machines ...)

It appears that, with no other tasks in the Amiga, I really wouldn't need to bump the priority. I'm pretty sure the not-quite-as-regular steps I see on the Amiga are indirectly my own doing. Once a tween I go through the calculation phase twice. Generally the drawing stage is so much greater in terms of time that this isn't noticed. However, with the Amiga in 5 bit-planes and the blitter well massaged, I have the situation where the Amiga draws faster but calculates slower than the ST. Thus, I'm pretty sure it's my double calculation.

amiga/main #3519, from cheath (Charlie Heath)
a comment to message 3517

Have you tried running Animation in FAST mem to see if that makes a difference?

amiga/main #3522, from jim_kent
a comment to message 3519

It makes a wonderful difference! It runs noticeably (20-30% perhaps) faster.

amiga/main #3526, from tholloway (Tim Holloway)
a comment to message 3503

There IS a SetPriority function in the Amiga EXEC, although some people have been known to cheat and reset the TCB priority themselves.

A MILLISECOND TIMER

amiga/softw.devlpmt #1979, from melphase4 (Mel Fishman)

I have a request from my son to place the following request for help re a Timer he is working on in the Graphics Lab at Waterloo. If you can't answer him directly, please leave a message for me and I will pass it on.

Here we go...again

Well, in quest of a 1-millisecond stopwatch before going to hardware, we have decided to give the 8250(-B) chip a chance. I am getting nowhere with it. I cannot seem to get the timer to do anything. What I am doing is:

I am setting up variables like so:

```
SHORT    *timer_low_A (= 0xbfd400)
SHORT    *control_register_A (= 0xbfde000)
         *control_register_A = 0x71
print    *timer_low_A
```

(note that the numbers in brackets are assigned at another point in the program)

The problem arises in that timer_low_A does not change at all. I have also tried playing around with PRA, and DDRA (is that a typo in the hardware manual? I am assuming that DDRA = 0xbfd200 and DDRB = 0xbfd300) but regardless of what I do, timer_low_A does not change.

I would like to be able to eventually have timer B count down and cause A to decrement on B's underflow, but if I cannot even get A (or B for that matter) moving, I am stuck.

If anyone can help me with this problem or present a better way to get a 1-millisecond grain timer, I would really appreciate it. I do not want to use hardware, because it would be harder to run the experiment simultaneously and publish our algorithms.

(A recap of the problem for those who forgot or are new:)

I need to be able to calculate the time from when a stimulus is displayed on the screen to the point in time when the user presses a mouse button. (I am using Manx C on a 512K Dual Drive System.)

Thank you very much.

amiga/softw.devlpmt #1985, from cheath
a comment to message 1979

Mel - here are a few ideas about the millisecond timer. First off, I'm pretty sure the two timers in the 8250s are "reserved" by the EXEC and device drivers, so programs are not "supposed" to make direct access to them. Timer requests are supposed to be made by using the timer.device, which has two modes of operation - one of which is based on vertical blanks (in increments of 16 milliseconds), and one of which uses the 8250 timer for microHz resolution.

It would seem that the microHz timer device would be the way the Amiga is "supposed" to let you do precise high-speed timing. However, from my not-too-deep experience with the timers, their precision for timing short durations is not very good.

Another possible solution to your son's problem would be to use the vertical position register as a

(continued)



timer. The vertical position register (VHPOSR and VPOSR) indicates precisely which scan line on the display screen the video beam is positioned at, and is a very precise timer. Each video frame takes something like 16.67 milliseconds and each frame is composed of about 250 (blast it, I forget exactly how many) vertical lines - thus, by reading the vertical position you can get a timing resolution of something like 70-microsecond precision. You'd have to figure out the exact numbers, but that should be doable.

Another thing to take into consideration is all the sources of delay in the Amiga due to interrupts and multitasking. Precise timing is more difficult because lots of things can happen to snatch the CPU away from the program that's trying to do the timing.

In the case of these lab experiments, probably the best thing to do is to call "Disable" after the display has been done and not re-enable until after the mouse button input has occurred. That is assuming the mouse button is being read directly, not as an "input event" under the input.device - because the input.device needs interrupts enabled in order to work.

Also - I question the precision of the whole experiment at the millisecond level, because the display itself is only updated every 1/60th of a second. You could improve the accuracy by timing the display update to occur based on the position on the display screen, taking into account where the thing being displayed on the screen is, timewise, according to its vertical position onscreen.

Well, anyhow, good luck to Flynn and let us know how he eventually solves this problem.

---

amiga/softw.devlpmt #1998, from melphase4

I would like to pass on Flynn's answer to cheath. Any assistance would be appreciated. Here we go:

To: M.FISHMAN (PFD001)
From: F.FISHMAN (PFD006)
Subject: More on the millisecond timer.
Reply to the reply to 1979

After sending my letter out to my father, I realized that this was a first time posting to BIX, and that I did not properly tell of all my failed attempts. So I will explain some of what I did while I reply to cheath's posting. (Thanks cheath; you approached all of the problems exactly as I did. I guess that means I am not so stupid after all.)

>First off, I'm pretty sure the two timers in the
>8250s are "reserved" by the EXEC and device drivers,
>so programs are not "supposed" to make direct access
>to them.

There are two 8250 chips; 8250 - A and B, each with two timers, a and b. 8250A is used for serial communications and Vblitter sync, 8250B is used for keyboard and as a virtual timer device. Luckily, I am not doing any serial communicating or Vblitting, leaving A available to me.

>Timer requests are supposed to be made by using
>the timer.device, which has two modes of operation -
>one of which is based on vertical blanks (in
>increments of 16 milliseconds), and one of which
>uses the 8250 timer for microHz resolution.

Agreed, the two timers are microHz and VBlank; unfortunately, they both seem to work on a 16-millisecond grain, and in fact seem to be identical from my program's point of view (i.e., poll the timer 1000 times, stuff it into an array, and then print the array). However, the microHz timer is supposed to be programmable. Does anyone know how to program it?

>(VHPOSR and VPOSR) indicates precisely which scan
>line on the display screen the video beam is
>positioned at, which is a very precise timer.

This was my second idea (and still a usable one). What we hoped to do is read the y-raster location (C is not fast enough to get an accurate x location) and then put this together with the timer to give us an accurate time. However, the y-raster location is not correlating with the timer. You'd think it would, since they both are 60 Hz (i.e., every time the timer makes its 16-millisecond jump, the y-raster should have the same value every time. WRONG; it doesn't. The y value decrements every 16-millisecond jump.). To use just the y-raster and nothing else is feasible, except that would require a counter incrementing every time the screen refreshes, and since we discovered the y-raster sometimes skips or inserts funny numbers we do not know how reliable this will be on several-second values.

>Another thing to take into consideration is all >the sources of delay in the Amiga due to interrupts >and multitasking. Precise timing is...

>It can be assumed that there will be no >multitasking and the Amiga will only be doing this >one timing at this one time.

>Also - I question the precision of the whole >experiment at the millisecond...

A millisecond is needed in this experiment (so I have been told over and over). You should have seen the original posting on UNIX though, that asked for a microsecond timer. I hate decimals. :-)

Well, I really appreciate your time, cheath. One of these days I will get this timer licked (either that or the summer will end, I will go back to school, and I won't care no more :-)).

---

amiga/softw.devlpmt #1999, from jdow (Joanne Dow)
a comment to message 1998

Um, there is a problem using the vertical times as a timer reference if you need extremely long-term accuracy. The time interval of the vertical interval is not a constant on the Amiga or any other machine that can switch between pure NTSC and non-interlaced NTSCish video. Each scan line is an exact time period related to the NTSC color subcarrier frequency. (Fhoriz = F_color_subcarrier*2/455 = 15734.265734 Hz. This implies a horizontal period (averages over oscillator noise and to the accuracy spec of the oscillator) of 63.55555555555 microseconds).

Given the 63.555-microsecond horiz interval we can calculate vertical intervals. In pure NTSC there are 262.5 lines (the .5 gives the interlace) per vertical interval. This means each pure NTSC field takes 16.68333333 milliseconds for a vertical period of 59.94005994...Hz. If we take the non-interlace mode with 262 scan lines exactly per vertical interval, the numbers become 16.6515555 milliseconds and 60.05444937 Hz. If you are into making long-time interval measurements, this can throw your computations of time out the window by a substantial error percentage. (Sustantial, she says - I guess I worked with precision timekeeping apparatus too long in earlier days... Methinques I nit-pick too much. Both coses are off by approximately .1% or about 1 minute per day.)

<^_^>

---

amiga/softw.devlpmt #2000, from jim_kent
a comment to message 1998

It is NOT safe to assume you won't be blitting or involved with multiple processes if you are using Intuition at all, or displaying text, or using the graphics libraries, or reading anything from a disk.

---

amiga/softw.devlpmt #2001, from cheath
a comment to message 1998

Mel - Flynn could set up a vertical blank interrupt to count the number of VSYNC intervals and not use the timer.device at all.

---

amiga/softw.devlpmt #2002, from jdow
a comment to message 2000

Indeed, while you might not be, some other process or program or whatever you wish to call it will very *likely* be doing so. Hence the calls through the OS are the only proper way to do these things.
<^_^>

---

amiga/softw.devlpmt #2004, from cheath
a comment to message 2002

Well, it sounds like Flynn's application is quite controlled (i.e., it is a lab experiment rather than a commercial product). Even so, there is a lot going on in the Amiga timing-wise that can make precise timing difficult.

Flynn - if you're using the mouse for input, the two buttons are not identical in timing. One is a direct input, but the other is a capacitive/resistive discharge reading - which takes about 1/60th of a second to read from the time the button is depressed.

APPLICATIONS FOR REVPATH

---

amiga/softw.devlpmt #2047, from bjackson (Brian Jackson)

Charlie (or ?): Did anyone ever decide if REVPATH (reverse text rendering - right to left) is working? I need to write a teleprompter program and, as the text is displayed in a mirror before the camera lens, it needs to be rendered in reverse (thank the Powers That Be for FontEd!). Sure would make the task simpler (I think).

PS - We're building a TV station and yours truly "gets" to do all the computer reality for the station. (And where's EtherNet ??)

---

amiga/softw.devlpmt #2048, from cheath
a comment to message 2047

Ah, so not only do you need the text displayed backward but also it has to be mirrored. I don't think REVPATH is intended to do that ... you'll have to do a custom routine to pull that one off.

---

amiga/softw.devlpmt #2050, from althoff (Thomas Althoff)
a comment to message 2048

How about REVPATH with a custom font of reversed characters?

---

amiga/softw.devlpmt #2053, from jdow
a comment to message 2047

It may be easier to reverse the wires on the yoke of the reverse monitor. Then all goodies will still render normal on a normal monitor for easy debug and type check. Hook to the reverse monitor for actual use and run with it.

<^_^> (That should be a 5-minute hardware hack, given a schematic of the thing.)

---

amiga/softw.devlpmt #2054, from bjackson
a comment to message 2048

Yep. The text has to be mirrored. While REVPATH won't handle THAT, it should be able to do its standard (?) act on a custom font(s), eh?

---

amiga/softw.devlpmt #2055, from bjackson
a comment to message 2050

Yeah, that's what I had in mind. The scroll routines shouldn't be too difficult to implement. I already have one font done. Actually, I guess that all you'd really need to do is create the text on a line-by-line basis, padding the end (beginning?) to a standard length and have Amy print the thing normally (left to right). Amy can sure handle this faster than the "on-air personalities" can read it. The mirroring is the trick. Thanks.

---

amiga/softw.devlpmt #2057, from bjackson
a comment to message 2053

I had a message on my local BBS from another hardware freak that said you could do that. Question: does this 'mirror' EVERYthing? I mean if THAT'S all I need to do....

What we're doing is networking several Amigas (at my insistence) through Ameristar's thingie (if/when...). That way the staff can all have access to the central files. And so can the control room and newsroom. This is valuable for quick editing almost "on air." If we can use the same system and just reverse one monitor while everyone else can see things normally it would be

(continued)

```
a real saver.  Could you just install a switch on the
monitors to have them reverse at will?   GEEEZ I love
BIX!

   Thanks to all you guys for your ideas and answers!
```

```
amiga/softw.devlpmt #2058, from jim_kent
a comment to message 2050

But the drawing of characters in a single line is so
fast that I don't think it'd matter if it were backward
anyway.  Why not convert "this is a test" to "tset a si
siht" and print it normally in your mirror font -
providing you can't get the REVPATH to work.
```

```
amiga/softw.devlpmt #2065, from jdow
a comment to message 2057

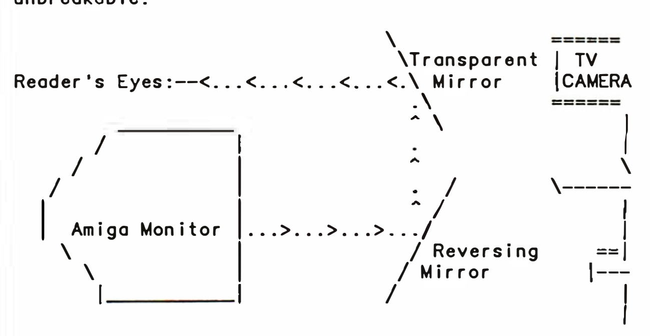
Likely as not, a switch could be installed and work on
a black and white TV. On a color, the convergence would
certainly suffer. (In fact the convergence circuitry
might make the yoke reversal more difficult as well. I
wos definitely thinking in terms of BW text for
teleprompter applications. Am I wrong?  If so the hack
might take a couple hours of thinking, 20 minutes
doing. And perhaps an hour or two reconverging the set.
For that matter, doesn't Conrac make such monitors?)
   <^_^>
```

```
amiga/softw.devlpmt #2066, from althoff
a comment to message 2058

I like that idea, Jim. Simple but effective!
```

```
amiga/softw.devlpmt #2127, from rsimonsen (Redmond
Simonsen)
a comment to message 2047

Why not just use TWO mirrors to UNreverse the image?
All you need is a front surface mirror for the lower
mirror to keep the letters looking sharp for the
transparent glass mirror.  I would suggest an
experiment with the Mylar mirrors made for shower
rooms. They are cheap, bright, lightweight, and
unbreakable.
```



ATARI ST

The Atari ST window for this month is devoted to software problems. To begin, one BIXen is writing a (fast) print spooler and sounds an open call for advice. Next, there is some concern when multiple copies of files begin appearing on various disks, and finally there is a discussion on structure name space standards for C, with an authoritative answer from a member of the ANSI standards committee.

WRITING A PRINT SPOOLER

```
atari.st/tech #421, from sgrimm (Steve Grimm)

I'm writing a print spooler for the ST (got sick of
waiting for the printer).  I'm using the 200-Hz system
timer and a hook into the TRAP #1 vector.  Anyway, I
need to output a character to the parallel port during
```

the interrupt; obviously I can't use a Cprnout() call. Do I need to do anything more than store a 0x0F to the PSG Register Select (0xff8800) then put my data to the PSG Write Data at 0xff8802? Thanks in advance for any help.

---

atari.st/tech #422, from jsan (Jez San)
a comment to message 421

You are putting your own vector at TRAP #1, so you intercept all printed characters before the OS gets them. You are then buffering them and using the 200-Hz timer to (supposedly) output your buffered text on the interrupts to the printer.

When you put your vector into the TRAP #1 slot, you must have revectored it back to the right place so that all other traps will work, right!?

So, whenever you wanna print something, all you do is emulate what the TRAP would do, by jumping to the *old* TRAP #1 vector address, with the stack appropriate setup so that when the routine does an RTE, it will return properly.

If you want any help with this, lemme know.

---

atari.st/tech #423, from sgrimm
a comment to message 422

I had thought of that. I was just trying to speed things up a little by not bothering with an OS routine to do all my work for me.

---

atari.st/tech #424, from davjon (David Jones)
a comment to message 423

I thought you weren't supposed to do OS-driven printer I/O from interrupt handlers. I remember seeing a message in this topic from jtittsler on calling BIOS from interrupts. I would have thought that GEMDOS calls would be entirely out of the question, as it's not supposed to be re-entrant. I think directly outputting the chars (not forgetting the handshaking) would be best.

---

atari.st/tech #425, from jsan
a comment to message 423

You are only running every 200 Hz. The Printer Output OS call can't be that slow, can it?

Poking the Sound-Chip's registers to get printer output sounds like going a bit far, when all you want is a simple way of printing characters. Also, what if the User has selected Serial Printer in their options table. What then? You going to do your own Serial Driver too?

I still maintain that using the legit OS way of printing characters by going through the vector that TRAP #1 would have gone through (assuming you altered it) is the best way.

There may be a problem of nesting GEM calls too far, but at the 200-Hz interrupt rate, I suspect this will never happen.

Beware of interrupt routines that do OS calls, though.

---

atari.st/tech #426, from jsan
a comment to message 424

What about Serial Printers?
Who says anything about re-entrant code? That doesn't have much relevance, does it?

---

atari.st/tech #427, from davjon
a comment to message 426

(continued)

Well, suppose the interrupt occurred in the middle of a chunk of GEMDOS code. I would have thought that would cause a headache or two. I can't say I have tried using the printer from an interrupt, but I have tried using sound-chip BIOS routines - and they bombed out until I read the msg from jtittsler (#279 I think). Another problem you might have is if the buffering interrupt happened in the middle of a previous buffering call (say the printer's a bit slow). I can see that serial printers would be excluded, although you could directly poke the MFP chip. Isn't there meant to be a table of I/O driver vectors for LST and PRN devices? That would be easier to intercept than TRAP #1s.

---

atari.st/tech #428, from jsan
a comment to message 427

Atari's HHG documentation does say that GEMDOS calls can be nested quite a few levels deep (6, I think). So I assume this to mean that if you're inside one GEMDOS call call, and an interrupt occurs, you can at least use Printer Output.

If you can't, then I'm even LESS impressed with GEMDOS. How else do they want us to do it?

---

atari.st/tech #429, from jim_kent (Jim Kent)
a comment to message 428

It's hard to write 6-deep re-entrant code. Usually it's 1 or 2, make a big effort to get it to 3, or when it's infinitely re-entrant it gets simple again - just shove everything on the stack.

---

atari.st/tech #430, from davjon
a comment to message 428

P'raps you're right, Jez, but I thought that only BIOS calls could be nested - printer buffering is not something I have done (or intend to do). Every buffering source code I have seen has used desktop accessory code to do the job, which is crude, but I suppose it works.

---

atari.st/tech #431, from jtittsler (Jim Tittsler)
a comment to message 421

You need to be VERY careful if you intend to mess about with the PSG since the operating system is using it periodically to check on disk changes. Changing the register select and the output must be done atomically, lest your data go somewhere you had not intended.

Unfortunately, the state of the register select latch cannot be preserved. Also, in the scheme as you have defined it, you must also toggle the strobe bit (and hopefully check the printer status bit).

GEMDOS FUNCTION $07

---

atari.st/tech #433, from dbetz (David Betz)

I wanted to upload my adventure writing system tonight, so I was trying to get rid of the last known bug. The adventure system displays a <<MORE>> prompt at the bottom of the screen when a single message contains more text than will fit on the screen with scrolling off. I implement this by printing the <<MORE>> prompt and then calling GEMDOS (or TOS) function #07 to wait for a character from the keyboard. I then return to

the program that does the printing to dump out another screen full. The problem is that after the first call to function #07, all subsequent calls seem to return the same character without waiting for the user to hit a key. The result is that you get automatic paging for one page and then everything else scrolls off the screen. Has anyone else noticed this behavior? Is there a bug in function $07 or am I doing something wrong?

---

atari.st/tech #443, from sak (Sal Magnone)
a comment to message 433

I haven't tried it but that's the first I've heard of it. Have you tried calling GEMDOS(8) yet? It should be the same.

---

atari.st/tech #452, from neilharris (Neil Harris, Atari Corp.)
a comment to message 433

Make sure you read all the characters from the buffer BEFORE attempting each GEMDOS #07 call.

CONSOLE INPUT PROBLEMS

atari.st/c.language #107, from padams (Patrick Adams)

Using DRI C68, we have discovered that a carriage return does not serve as a new line for console reads. It is necessary to enter a ^J (linefeed) to terminate the input. The problem is with fgetc reading stdin. Is there another function we can call?

---

atari.st/c.language #108, from jruley (John Ruley)
a comment to message 107

Try rawcin (I cannot remember the function number - check your BIOS refs).

---

atari.st/c.language #110, from chriskuku (Christoph Kukulles)
a comment to message 107

The problem is known. It lies in fgetc or below. I'm working on the bug and hope to get it solved soon. I don't want to switch to another compiler just because of this bug.

---

atari.st/c.language #111, from alexl. (Alex Leavens)
a comment to message 107

Cconrs works, although you'll have to be careful. It's documented WRONG in the BIOS manual.

THE CASE OF THE MULTIPLE FILES

atari.st/tech #461, from dbetz

Help!!
I just discovered one reason I was having so much trouble getting single-character input to work on the ST. I had SIX COPIES of int.prg on my floppy! What causes the ST to allow multiple files with the same name on the same disk and in the same directory (root in this case)? This is a *serious* problem. Does anyone know what causes it?

---

atari.st/tech #464, from wes.peters (Wes Peters)
a comment to message 461

It seems that sometimes, if you Fcreate a file that already exists, GEMDOS doesn't delete the old file; it just creates a new one with the same name. I use my own 'open' function, which checks to see if the file exists, and if so, Fopens it; if not, Fcreates it. A bit slower, but no more duplicate files. The routine is quite simple and is left as an exercise for the reader. (I've ALWAYS wanted to say/write that!)

---

atari.st/tech #466, from mmallett (Mark Mallett)
a comment to message 464

It's OK to write a new open() routine, but I have gotten duplicate files produced by various purchased programs, as well as from desktop operations. I don't have any control over that.

---

atari.st/tech #486, from sprung (Ron Sprunger)
a comment to message 473

Likewise here. I've gotten up to four copies of a file with the same name before noticing. It has happened from the desktop as well as from the C-Shell. It happens just seldom enough that my trust is built up, then it clobbers me - about every two weeks or so.

---

atari.st/tech #494, from dbetz
a comment to message 464

That sounds like a "workaround" for a bug in the operating system. In my case, it is the linker that is creating the duplicate file, so I have no control over how it does so. I suppose I could get my shell script to delete the target file before running the linker, but what about people who use the GEM environment? They don't have a shell to program that way.

---

atari.st/tech #495, from dbetz
a comment to message 473

Is anyone building a list of bugs in GEMDOS? I'd like to see it. It seems there are quite a few for a system that has been committed to ROM! Is the ST ROM structured like the one in the Macintosh so that it can be patched? The Mac vectors most routines through RAM so you can do patching. Does the ST?

---

atari.st/tech #498, from batterlesinc (Mark Skapinker, Batteries Included)
a comment to message 495

I put up a list of bugs that I knew about, and yes, the ROM can be patched (as in the ROM patch from Atari for PLAYandRECORD). Well, Neil, how about compiling a list?

---

atari.st/tech #499, from sgrimm
a comment to message 494

I've never gotten a duplicate file on any of my disks. Whenever one of my programs calls Fcreate, the old file is overwritten. Perhaps everyone has an older version of TOS?

---

atari.st/tech #501, from dbetz
a comment to message 499

I am using a relatively recent 1040ST with TOS in ROM. I assume there is only one version of the ROMs, so I think I have the latest stuff.

---

atari.st/tech #509, from sprung
a comment to message 501

Neil asked about version also, but I'm using TOS in ROM and assume, as you, that there is only one version - if not true, would appreciate the info.

NAME SPACE CONFLICTS IN C

atari.st/main #173, from davep [David Pollak]

[Editor's note: Message #173 was a long one dealing with the relative merits of various compilers. We pick up the thread with a response to a specific part of that message.]

---

atari.st/main #273, from wes.peters
a comment to message 173

I'm waiting for the Manx compiler or a good un*x clone with decent performance AND the capability of running (one) GEM application on the 'console.' By the way, the 'name space' conflict you're noticing with



• BEST OF BIX • BEST OF BIX • BEST OF BIX •

structure offsets is a part of the definition of the C language. K&R mentions somewhere (in Ch. 7, I believe) a standard of making every structure-member name begin with a two-letter mnemonic for the structure name so name space conflicts will not occur. A holdover from their PDP-11 assembler, I guess. Remember, it's been documented, so it's not a bug, it's a feature!

---

atari.st/main #274, from wes.peters

BLT: Was originally implemented on the PDP-7, I think. It was an instruction for transferring blocks of memory words from one location to the other. Also, a sandwich containing bacon, lettuce, and tomato. From the 'Jargon' file.

---

atari.st/main #275, from cheath (Charlie Heath)
a comment to message 274

Re: 64K data areas. If you use offset addressing (like Aztec) you can address +/- 32K bytes.

---

atari.st/main #293, from mmallett
a comment to message 273

You are quite right in saying that the "name space conflict" between different structures is upheld by K&R (page 197, to be exact). You have to keep in mind that while the K&R book is THE reference for the C language of its time, C has undergone a number of changes since 1978. At this point, any compiler that does not maintain separate name spaces for structure members has to be considered deficient.

Anybody know what the ANSI proposal has to say on this topic?

---

atari.st/main #302, from jim_kent
a comment to message 293

ANSI says you get separate name spaces for separate structures. ANSI says void is cool. ANSI also says that:

```
extern putc(char c, FILE *f);
```

is not only compilable but will check your parameter passing for you.

Unfortunately, this last ANSI feature has yet to be implemented in any compiler I've found. The first two are quite common. Megamax C, Lattice C, (and hopefully soon on the ST) Aztec C all give you separate name spaces for structures.

---

atari.st/main #303, from al (Alastair Mayer, author of BIX's CoSy Software)
a comment to message 302

The only C compiler I've seen that *doesn't* give you separate name space for structures was on an old Berkeley UNIX release for PDP-11s. Caused a few headaches when porting some software to it.

---

atari.st/main #305, from jim_kent
a comment to message 303

You haven't seen the Alcyon one?

---

atari.st/main #310, from shersee (Steve Hersee, Lattice)
a comment to message 293

ANSI requires separate name spaces for almost everything. BTW, the ANSI committee voted the standard out for internal letter ballot. This is a major milestone since, once the letter ballot is passed, changes to the standard will take 2/3 vote, not majority. I will be commenting more about this meeting in c.language and lattice.

Steve Hersee
International Rep X3J11
IOS WG14 C standards convener

---

atari.st/main #311, from shersee
a comment to message 303

The OS-9 C compiler also does not support unique structure member names.

---

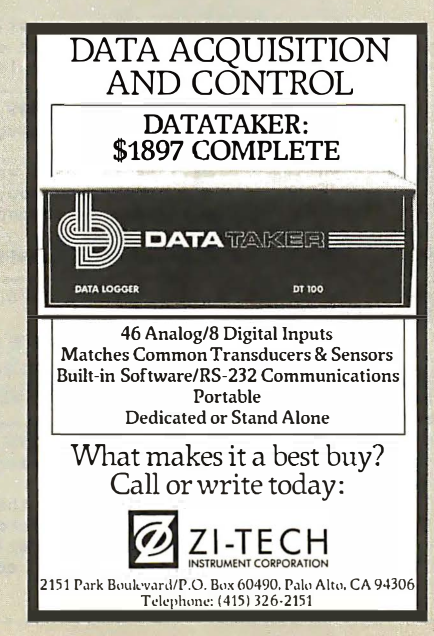
atari.st/main #312, from jimomura (Jim Omura)
a comment to message 311

The current 68K version does. The 6809 version doesn't.

---

atari.st/main #313, from shersee
a comment to message 312

At the micro show in Japan two weeks ago, the documentation still listed this limitation.



```
atari.st/main #314, from jimomura
a comment to message 313

Peter Dibble, who has it, says the limitation isn't
there anymore. :-)
```

```
atari.st/main #315, from bmoore (James W. Moore Jr.)
a comment to message 314

The Microware V2.0 68K C compiler *does* support unique
struct names.  The 2.0 release also allows up to 256
character identifier names, has PCC-like type checking
warnings and a bunch of other goodies.  I'd not
consider the Japanese market representative of the
state of the art at Microware.  It takes a month just
to send the update to Japan.  After that, the stuff has
to be translated and configured for the different
machines.  OS-9 updates in Japan usually lag the US
market by 4-6 months.  The V2.0 C compiler was released
in March 1986. [K. Kempf]
```

IBM PC AND COMPATIBLES

The IBM conversations chosen for inclusion this month have a common theme: the display. The first thread begins with BYTE Consulting Editor Jerry Pournelle attempting to de-blink his cursor. The second concerns a snow-plagued screen and the effects of writing directly to the display adapter. The last thread answers the question: How do I change the default color on my CGA display? Finally, an omission from an earlier Best of BIX is rectified.

TURN OFF THE BLINKING CURSOR

```
ibm.pc/pc.software #1177, from jerryp (Jerry Pournelle,
Consulting Editor, BYTE)

I don't get a chance to get here often, so I would
appreciate a positive answer copied into
tojerry/queries.

   Does anyone know a clean and elegant assembly
language way to turn off the blinking cursor on on IBM
PC and make it a transparent blob for using in word-
processing programs?
```

```
ibm.pc/pc.software #1178, from skluger (Sigi Kluger)
a comment to message 1177

The only way to unblink the cursor is by hardware
modification.  I have unblinked all the systems I use
and it usually takes only 5 minutes.  Somewhere on BIX
I have written up exactly what to do - will have to
find it.  Also, it'll appear in MicroC some day.  Oh,
unfortunately, the only useful non-blinking cursor is
an underline since there is no hardware to reverse the
character beneath the cursor.  That'll be another
challenge, and one of these days I'll do it.
```

```
ibm.pc/pc.software #1179, from rschnapp (Russell L.
Schnapp)
a comment to message 1177

To kill the cursor entirely, you have to position it on
the nonexistent 26th line, using the BIOS video
interrupt.  The code should look something like

    MOV DX,1901H
    MOV AH,2
    XOR BH,BH     ;Set the page number
    INT 10H

   If you want to leave the cursor on but kill the
blinking, I'm pretty sure you'll have to cut a trace or
two on the video board.
```

(continued)

SNOW IN JUNE

ibm.pc/pc.software #1192, from aburnett (Andrew Burnett)

I am having a problem with snow on my XT. I am trying to write directly to the video RAM so that the display will be updated fast enough. However, this causes a lot of snow to be produced. I am told that this can be overcome by writing only during horizontal and vertical blanks. Does anyone know how to do this in C or assembler?

ibm.pc/pc.software #1193, from uclvms725 (John Leonard)
a comment to message 1192

You need to set a loop that checks, waits for a video retrace, and then outputs your string to the video RAM. You must monitor bit 3 of I/O port $3DA. When the bit is set to 1, then the video is retracing and you may update the screen. When bit 1 is set to 1, you may update the buffer (only on color monitors with more than 4K of screen RAM). A simple "while not - do" loop or a "repeat until" loop will work fine. Refer to the IBM technical reference manual or page 95 of Norton's Programmer's Guide to the IBM PC.

A Turbo Pascal Example:

```
while not ( (port[$3DA] and 8) = 8 ) do;
```

This performs an empty loop while the proper bit is not set. I hope this helps.

ibm.pc/pc.software #1194, from jimkeo (Jim Keohane)
a comment to message 1193

Very nice, John. Andrew might also want to check out assembler/cpu8088 #126 where I posted C-callable assembler routines for block moves to/from CGA video.

assembler/cpu8088 #126, from jimkeo
a comment to message 125

>Wait for a video retrace...
1. For vertical retrace (30 times a sec) but you can move 40-100 words at a clip:
While (port[$3da] and $08 = 0) do;
2. For horizontal retrace (6000 times a sec) but you can only move a byte or a word at most on normal PCs:
Here's assembler code for a C-callable routine:

m(@fromi,@screen,words) ". Moves attr/char's from offscreen to CGA regen area...

```
    ; mem2scr(@memloc,@scrloc,words);
    code    segment byte public
            assume  cs:code
    dseg    proc  near
            public dseg
            mov     ax,ds
            ret
    dseg    endp
    m       PROC NEAR
    PUBLIC  m
            PUSH    BP
            push    ds
            push    es
            MOV     BP,SP
            MOV     cx,[bp+16]
            mov     di,[bp+14]
            mov     es,[bp+12]
            mov     si,[bp+10]
            mov     ds,[bp+08]
            mov     dx,03dah
            cld
    slow:   lodsw
            sti
            push    ax
            cld
    slo:    in      al,dx
            test    al,1
            jnz     slo
            cli
    shi:
            in      al,dx
            test    al,1
            jz      shi
            pop     ax
            stosw
            sti
            loop    slow
            pop     es
            pop     ds
            POP     BP                      ;get frame ptr
            RET                             ;return pop 0
    m       ENDP
    mm      PROC    NEAR
            PUBLIC  mm
            PUSH    BP
            push    ds
            push    es
            MOV     BP,SP
            MOV     cx,[bp+16]
            mov     di,[bp+14]
            mov     es,[bp+12]
            mov     si,[bp+10]
            mov     ds,[bp+08]
            mov     dx,03dah
            cld
    islow:
            in      al,dx
            test    al,1
            jnz     islow
    ishigh:
            cli
            in      al,dx
            test    al,1
            jz      ishigh
            lodsw
            sti
            push    ax
            cld
    islo:   in      al,dx
            test    al,1
            jnz     islo
            cli
    ishi:
            in      al,dx
            test    al,1
            jz      ishi
            pop     ax
            stosb
            sti
            loop    islow
            pop     es
            pop     ds
            POP     BP                      ;get frame ptr
            RET                             ;return pop 0
    mm      ENDP
    code    ends
            END
```

The "slo" loop waits til yer not in vretrace. "shi" then waits for start of vretrace. This is to give you the biggest window so you can store a word.
"mm" routine moves from screen to screen.

CGA DEFAULT SCREEN COLORS

ibm.pc/pc.software #1202, from gilwilliamson (Gil Williamson)

OK, I give in. I've had this PC with CGA for 1.5 wks now, and I can't find the DOS command to put the default text color into something other than white on black, which I hate. How's it done?

Anyone care to recommend a nice assembler for the PC? This is an AT, if the extra capacity helps.

I'll be getting the Norton programmer's book. Anything else vital?

ibm.pc/pc.software #1203, from dondumitru (Donald Dumitru)
a comment to message 1201

The INT 27 method only works for .COM files. The INT 21, function 31 method will work for .EXE files. Also, the function 31 method allows you to return an error code when "terminating."

Microsoft wants you to use the newer method. When they make a recommendation like "is the preferred method," that's a hint that the unpreferred method may not work in the future.

---

ibm.pc/pc.software #1204, from skluger
a comment to message 1202

As far as assemblers go, to be compatible with everyone else, MASM is probably the one to go with (ugh!). If you wont to make it easy on yourself by not having to declare 2 pages of stuff to write a 2-line program, you might want to choose Digital Research's RASMPC/LINKPC/SIDPC combination. This has the neat advantage that any .EXE file created by them is totally incomprehensible to any debugger except SIDPC!

---

ibm.pc/pc.software #1205, from dondumitru
a comment to message 1202

DOS does not have a built-in command to change the screen color. Take a look at the ANSI.SYS device driver for an easy method. Install ANSI.SYS with a DEVICE=d:\path\ANSI.SYS statement in your CONFIG.SYS file. Change your prompt to $e[37;44m$e[K$p for white-on-blue letters. (This is just an example - you should find your own preference.) Also, there are a couple of programs around that will change the default display color to...whatever. Look on your local BBSs, or ask some local friends.

I would recommend Microsoft's Macro Assembler 4.0. It, and the tools it comes with, are great. 'Course, this is just on opinion.

You should buy IBM's DOS Technical Reference Manual if you haven't already. It has bunches of important stuff in it, especially if you are going to be programming in assembly.

---

ibm.pc/pc.software #1206, from gperfect (George Perfect, Byline Software Ltd.)
a comment to message 1202

Gil,
If you have the ANSI.SYS driver loaded, the easiest way to set screen colors is to include the ESCape sequences in your AUTOEXEC.BAT file. There was a message in the ms.dos conference with details. All info needed is in the DOS 2.0 reference manual.

We use the Microsoft assembler (MASM) V4.0 and find it quite adequate. It has a switch to generate 286 code if you want. You can order it from Grey Matter or direct from Microsoft in Reading, MA.

CORRECTION

In the June Best of BIX, there was a discussion concerning memory modifications to the IBM PC XT. Unfortunately, some critical details of the modification were not mentioned. Here is one of the messages from that discussion, and mail from the author that "fills in the blanks."

---

ibm.pc/xt.hardware #112, from dondumitru
a comment to 102

I have 640K on the motherboard - exactly as described in that modification. The modification involves (1) soldering a jumper between two solder pads (there just for the purpose of soldering a jumper to); (2) inserting a "decoder/multiplexer" chip into an empty socket (sorry, I don't remember the chip number); and (3) putting 256K chips into banks 0 and 1. Tada! 640K for minibucks. For an XT, this has to be *the* best way to upgrade your memory. For me, memory and the decoder/multiplexer cost around $80. I had it installed in 45 minutes. [Ed. note: The multiplexer/decoder chip is a 74LS158.]

From: dondumitru
To: curtf
Subject: Question from Best of BIX

1) The jumper is soldered between pads 1 and 2 in the pad set labeled E2 - this pad set is on the power supply edge of the motherboard, next to the motherboard's power connectors.

2) The chip socket is U84 - which *should* be empty before the modification is installed.

Hope this helps!
Donald

MACINTOSH

The Macintosh conference presents several interesting questions this month: There is a query regarding the existence of a DTR port on the Mac Plus. Then comes another on the performance of the Mac's stack pointers. The last two threads concern interaction with two types of formats, the PostScript page description language and the MacPaint graphics file. The Macintosh conference window closes with a letter in response to a previous Best of BIX.

A DTR PROBLEM

---

macintosh/softw.devlpmt #326, from cforrester (Christopher Forrester)

I am working on a project that involves the Mac receiving data on the serial port. As far as I can see the Mac did not support DTR. Does anybody know if this situation has changed with the Mac Plus?

---

macintosh/softw.devlpmt #327, from rgelen (Richard G. Elen)
a comment to message 326

According to my notebook, the Mac Plus modem port has an 8-pin mini-DIN pin-outed thusly (labeling pins from the top left, left to right, viewed FROM the machine):

1. DTR <---!!
2. DSR
3. TXD-
4. GND
5. RXD-
6. TXD+
7. (nc)
8. RXD+

It's RS422, really. Hope this helps.

---

macintosh/softw.devlpmt #328, from rgelen
a comment to message 327

(Let's be more precise: labeled 1-8 from the top left, left to right, looking FROM the machine, where 'TOP' means the edge AWAY from the notch in the plug. i.e., the row of only two pins at the top.)

MAC STACK POINTER

---

macintosh/softw.devlpmt #336, from cforrester

Am I crazy!
The following instruction in my program seems to produce some very strange results:

```
MOVEA.L 10(A1),A7
```

(continued)

at this point 10(A1) contains CB5C. After the instruction has executed, A7 does contain CB5C but the two bytes at CB5A and CB5B which contained D6 B4 now contain ED 4A. All this with one instruction!!

I am using TMON to diagnose the problem on a Mac Plus.
HELP!!!

---

macintosh/softw.devlpmt #337, from hedges (Tom Hedges)
a comment to message 336

An interrupt occurred (without your knowledge) and pushed stuff onto the stack (decrementing the stack pointer first). You just set the stack to CB5C so the memory below that address is now the stack -- which was exactly what I supposed you wanted to do by setting the stack pointer to that location. Remember that the stack is used by the interrupt world and one cannot hope for the data below the stack pointer to be preserved just because the base level application code doesn't use that part of the stack.

---

macintosh/softw.devlpmt #338, from mcgath (Gary McGath)
a comment to message 336

Sounds as if a trap is being taken after that instruction; but then I'd expect more than two bytes to be clobbered. In any case, CB5A is fair game for the stack once you've executed that instruction, and maybe TMON is using it one way or another.

PostScript

---

macintosh/qanda #362, from frankb (Frank Boosman)

On Saturday, my boss and I decided to go through with an experiment in using PostScript; if it works out, it will turn into a long-term project. I spent all of today reading Adobe's PostScript Tutorial and Cookbook, and I'm pretty excited about PostScript. It's an amazing vehicle for graphics production; I can see why it's become so popular.

Anyway, I have a couple of questions about PostScript, and I'm hoping that some BIXen or friend of a BIXen will have the answers.

1) PostScript's default unit of measurement is 1/72nd of an inch, also known as a point, and as logical a measuring system for graphics as any. Since 1/72nd of an inch is the smallest unit addressable in this scheme, the thinnest line that can be drawn is 1/72" thick. Yet the LaserWriter is capable of producing 300 dots per inch, and can therefore produce a line only 1/300" thick (PageMaker does it, incidentally). It's not immediately apparent that PostScript's SCALE operator accomplishes what I'm after. How can I draw at the full resolution of the LaserWriter?

2) In the Cookbook, Adobe provides some interesting algorithms in PostScript for handling mundane tasks (like breaking lines of text) and interesting tasks (like using outlined text in a manner similar to QuickDraw's setting a clipping region). But there are only so many algorithms that can be placed in one book; I'm after as many as I can find. Where can I find interesting PostScript algorithms? Is there a user's group, a newsletter, or some other forum where people trade tips and techniques in PostScript?

To whomever answers these questions, thanks a lot!

---

macintosh/qanda #365, from sroth (Steve Roth)
a comment to message 362

You can always print a PostScript file to disk to see how Apple and Aldus drivers do it!

---

macintosh/qanda #366, from rschnopp (Russell L. Schnapp)
a comment to message 365

Hmmmm. How do you get a Mac program to print PostScript files to disk? I know you can get MS Word to do it on the PC, but on the Mac?

---

macintosh/qanda #367, from frankb
a comment to message 366

To sroth: nice idea, but a spooled PostScript file produced from an application is almost unreadable, consisting mainly of undecipherable abbreviations and the like. It's possible, using FEdit, to open up the LaserPrep and AldusPrep files, but I'm told they are extremely difficult to decipher, being compacted, undocumented, and the like.

To rschnopp: to print a PostScript file to disk from any program, press Command-F immediately after clicking "OK" in the Print dialog box.

It looks like I found the answer to one of my questions, anyway: When specifying a point size for any drawing operation, real values can be used. A 1/300"-thick line would be about .25 point. Silly me. I just assumed it was an integer value. Too much QuickDraw.

---

macintosh/qanda #368, from lloeb (Larry Loeb)
a comment to message 367

Isn't there a new "PostScript escape" font that allows printing execution of PostScript files? Download 2.5 is an application from Apple that takes PS files and stuffs them into a LaserWriter.

---

macintosh/qanda #369, from jroble (Jonathan Roble)
a comment to message 367

Does the Command-F trick work for other programs?

---

macintosh/qanda #370, from frankb
a comment to message 369

To lloeb: the PostScript Escape font isn't really being distributed; it was just mentioned in MacTutor. The idea is to create a font of 1-pixel height and 0-pixel width. Type your PostScript program within a word-processing file, then convert the program to the Escape font. Voila! The Printing Manager sends it straight through to the LaserWriter.

To jrobie: yes, the trick should work with all software.

MacPaint File Format

---

macintosh/qanda #384, from bgifford (Bruce Gifford)

I am trying to create graphics and store them in a MacPaint file so they can be edited with MacPaint. I have two programs for displaying MacPaint files on the screen but both say the files have a 512-byte header at the front without giving any specific details. I have been looking for a week now for specifics of the MacPaint header format with no success. Any help or info as to where to find this info would be greatly appreciated.

---

macintosh/qanda #385, from ccrawfor (Chris Crawford)
a comment to message 384

Do you really need to know what is in that header? I have written code that takes MacPaint files and plays with them extensively, and my code just ignores the header. It still seems to be able to do everything I want to do, so why bother?

---

macintosh/qanda #386, from microprose (Russell Finn, MicroProse Software)
a comment to message 385

```
This is from memory, as I do not have the appropriate
document in front of me. With that said... the 512-byte
header contains a pattern list, i.e., 38*8=304 bytes
which represent the patterns defined for this document.
(You can edit the patterns in MacPaint, remember.)
Remainder is "reserved for future use," i.e., Bill A.
couldn't think of anything to put there.

   By special dispensation, if those bytes are all
zero, the "standard system pattern list" is used; this
is what you get when MacPaint starts up.  (In fact, it
is PAT #0 in the system resource file.  See IM I-473.)
Therefore you can skip the bytes when reading and write
a bunch of zeros without sweat.  The document in
question got sent out in one of the software
supplements (May '85?), but the info is correct
(barring neural parity error).  So is Chris -- just
ignore the header.
```

```
macintosh/qando #387, from jrobie
a comment to message 385

In fact, Apple's documentation on the MacPaint file
format says that you can go ahead and ignore the
header.  I have been doing just that in my programs,
and they work fine.
```

```
macintosh/qando #388, from bgifford
a comment to message 384

Sure appreciate your help.  I was under the mistaken
impression there was important data there such as
drawing dimensions that I could generate.  Just wishful
thinking I guess.  Thanks again and I will ignore the
header in the future.
```

The Best of BIX is usually reserved for conversations taken from the BIX conferencing system. Helpful technical information can, however, transcend the limitations of a prescribed medium. As proof, a letter in reply to items in the July issue. . .

Dear Sir,

The July issue Macintosh section contains an exchange between Mr. Hoffman (macintosh/softw.devlpmt #223) and Mr. Crawford (macintosh/softw.devlpmt #224). The information presented in #224 is misleading.

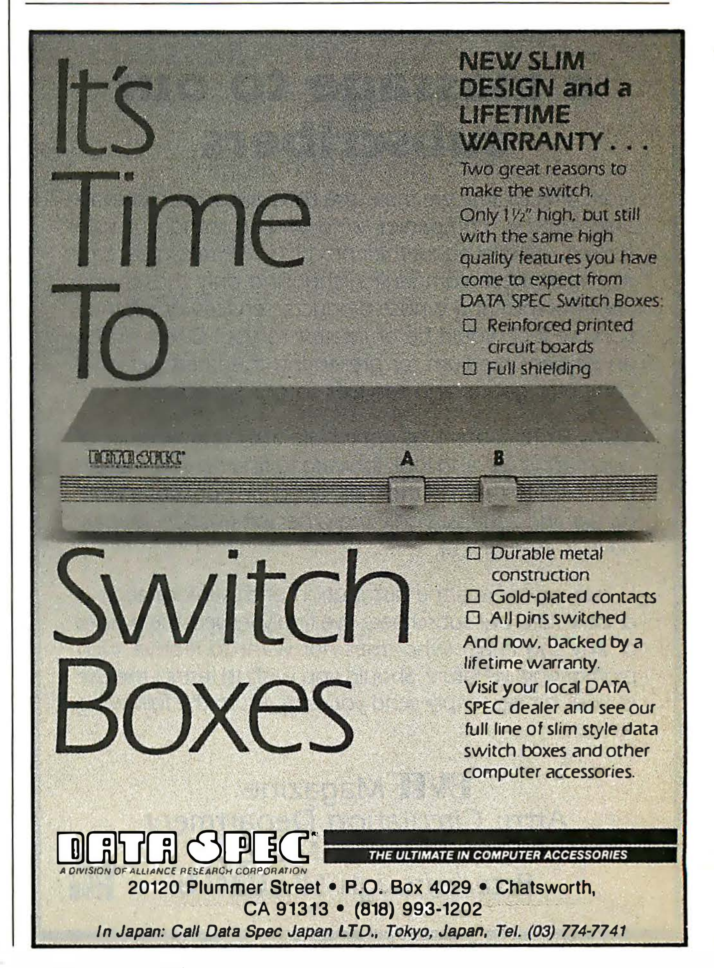
TML and Lisa Pascal define the byte data type as a subrange 0..255. As such, it requires a word of storage except in packed structures (array or record). The 68000 requires word and longword items to be allocated on even addresses. Since the variable "testptr" is defined as a pointer to Byte, addressing exception processing is entered when a word-length memory access is attempted with "testptr" off.

The solution to the problem in #223 is simple, however. Use a data type requiring a byte of storage. The type SignedByte is defined as a subrange −128..127, and the compiler allocates such data in byte storage. Type Ptr is defined as a pointer to a SignedByte. The compiler generates byte addressing code when such data is accessed. It will thus allow addresses without addressing exceptions.

By simply changing Byte to SignedByte as the type of "testbyte" (and ^Byte or Ptr), the code in #223 will work as desired. The complex alternatives offered in #224 are unnecessary.

J. P. Holden
Beaconsfield, Quebec, Canada

(continued)





S-100

While most of the news in recent years has been made by the IBM PC (and compatibles) or one of the 68000 flavors, the S-100 bus and CP/M operating system have remained cornerstones of a "workhorse" system for many applications. The s.100 conference on BIX gives aid, advice and comfort to those who choose to use and work on the "boat anchors." The conversations in this excerpt all focus on a variety of disk problems.

5¼-INCH DRIVES UNDER CP/M

```
s.100/general #61, from w_smith (William P.N. Smith)

One of the major problems that several people of my
acquaintance seem to have with running CompuPro Disk1-A
and 5 1/4-inch drives under CP/M is that no code exists
to do such a thing. Viasyn advertises "simultaneous"
5 1/4-inch and 8-inch but doesn't provide a BIOS to
drive them, and I know of no one else who does.  I am
about to start writing code to talk to my 5 1/4-inch
drives (probably using one 4K sector per track, in
multi-track mode, so that my DS 96TPI 5 1/4-inch and my
SS 8-inch drives will have the same capacity), but it
looks like a long-term project, and I'd really rather
not (at this time).  Has anyone written such code, or
does anyone know where I might purchase such a BIOS
already set up for this?  The strange thing is that the
Viasyn boot ROM for the Z-80 attempts to boot from a 5
1/4-inch drive on the third drive....
```

```
s.100/general #62, from w_smith

Has anyone played with the CompuPro Disk1-A floppy
controller?  Or the 765-type floppy controllers?  I am
trying to get it to talk to my 5 1/4-inch drives, and
while it seems to format the tracks OK, when I try to
read the tracks back, I get a status of:
    ST0      40H      (Abnormal Termination)
    ST1      01H      (Missing Address Mark)
and no data.  Any ideas?
```

```
s.100/general #65, from jandrews (Jerry Andrews)
a comment to message 61

Are you sure about that third drive boot?  I've not got
my BIOS written for my new 1-A, but that's the kind of
glitch I'd like to know about in advance!  I go through
a 2-step boot anyway, so it may not be a problem.  I
set up the RAM disk as disk A; warm starts and such go
REALLY fast!  I keep WordStar and SuperCalc and dBASE
on the RAM disk, and every other application is a
PUBlic file (AKA Dr. Dobb's).  Sure does make switching
back and forth from source code to editor fast!
```

```
s.100/general #67, from w_smith
a comment to message 65

Dunno if you have tried it yet, but the Disk1-A boot
ROM goes out and tries to boot from drive 0 as an 8-
inch, then drive 2 as a 5 1/4-inch, and loops on that
till you feed it a disk.  I seem to be having some
trouble with the basic I/O operations; the statuses I
read from the format program I wrote seem to be OK, but
for some reason I can't read the formatted tracks.  Do
I have to actually write something first, or should I
just be able to read the E5s off the disk?  READ ID
mode says things are OK on both sides of the floppy,
but READ DATA doesn't seem to transfer a single byte
and gives me Missing Address Mark status.  When you
format a track, is it formatted as deleted data?  Maybe
I'll try reading deleted data. The Compupro BIOS is
kind of hairy to wade through, and there aren't any
sources for their format program, so I _could_ be doing
something wrong with the format process.
```

```
s.100/generol #68, from jondrews
a comment to message 67

Uh... I've hod really lousy luck reading preformotted
disks.  You're way ahead of me on the 1-A, though;  I'm
working on a set of database routines for the local
YWCA, and haven't STARTED on the BIOS.  When I wrote my
first, I got the disk read/write routines working by
writing 01 through FF to the disk, then reading them
bock out.  That means you've gotto debug two routines
at once, but what the heck?  Another possibility (which
I haven't tried) is to write a SSSD disk with your old
BIOS then use it to debug the READ routine first.  I'd
suggest on immediately recognizable pattern other than
E5.  THAT could be read from anywhere on the disk.
Don't you wont to know where you're reading from?
```

```
s.100/generol #70, from w_smith
a comment to message 68

Wow, aren't you just a little worried about not having
started on the BIOS? See, I don't hove any capabilities
on my current BIOS to write (or format) a 5 1/4-inch
disk, so I had to write the format program first.
Actually, I hod to write the SPECIFY, RECAL, and SEEK
routines first, but who's counting?  I can do a READ ID
to ensure that I am where I wont to be, and that works,
it says the first sector encountered is sector 1, track
whatever, side 0 or 1, but when I try to read it....
Should sector numbers start with 0 or 1?  I've tried
both ways.  I have chosen on easy format of one single
4K sector per track, so that a double-sided 5 1/4-inch
drive has the same capacity as a single-sided 8-inch
drive.  I intend to have a full track (cylinder) buffer
of 8K in memory and move it off to another bonk in the
future.  My main problem now is that I'm not reading
anything at all, from anywhere on the disk.  Just to
have the thing dump E5s into memory would be a victory!
Then I con worry about writing and verifying and such.
Maybe I should toke up writing next and worry about
reading later.  At least I con tell if the FDC thinks
it has completed the write.
```

```
s.100/generol #72, from jandrews
a comment to message 70

Couple things...

   1) Sectors go 1 to n.  Tracks go 0 to 65535.

   2) No, you're right to stick with a read first.  I
haven't got any words of wisdom, but I'm sure
interested in what you end up with (slaver, slaver).

   3) Yeah, I'm worried about not starting on the BIOS.
But this is a PAYING CUSTOMER!  They get first dibs on
my free time.  I'm operating with (yer not gonno
believe this) 1 each 8" DSDD floppy, and 1 each 256K
RAM disk 'till I get that BIOS wrote.  Sigh.  It's
tough to be poor.

   Sounds like you're writing a pretty sophisticated
BIOS.  I'm leaving buffers in RAM to rev 3.  Are you
running CP/M 3 or a 16-bit machine?  I've not seen on
8K buffered system under CP/M-80!
```

```
s.100/generol #74, from w_smith
a comment to message 72

Well, I'll let you know what I come up with, I think I
read somewhere that with the Disk1-A, you ore expected
to get on abnormal termination at the end of the track,
cuz the FDC does not get a Terminal Count input at the
end of the lost sector, but I'm not getting any data,
and I think you ore supposed to get on end-of-cylinder
overrun error or something.  OOPS, I thought the BIOS
```

(continued)

was for your customer.... I've got 2 SSDD floppies and 64K of RAM, so I know what it means to be poor. The 5 1/4-inch drives are borrowed from my secondary machine for these tests. These things I'm trying may seem somewhat sophisticated, but I'm really taking the easy way out. By buffering the entire track, I don't have to worry about which sector to deblock. I don't expect to be able to use a few of my larger programs with another 8K chunk taken for my track buffer, but eventually I'm going to have to bank-switch some of these things to get my networking and track buffers (one for each drive in the final version, I hope). I just have a CPU-Z (Z-80) machine, but if I had some more memory and a couple of jdow's famous hardware hacks, I could do the bank-switching and free up a lot of room in bank 0.

s.100/general #75, from jandrews
a comment to message 74

My current OS runs configured as a "standard" 48K machine. I don't think you'll have any problem missing that 8K chunk. And I gotta agree: buffering to RAM is lots easier than figurin' out what to deblock!

s.100/general #77, from jdow (Joanne Dow)
a comment to message 71

Have you tried read track commands? This should tell you what your format routine actually places on the disks.
<^_^>

s.100/general #78, from w_smith
a comment to message 77

Well, Read Track on the 765 doesn't quite work the same as on the 179x, it reads all of the data from the track, and doesn't give you the format info and such. Worth a try, though, to see if I can get anything. Maybe Sunday if I get a free moment.

s.100/general #79, from jdow
a comment to message 78

Isn't there a 765 analog to the format operation? I thought there was a way to get it to simply read a whole track and forget about formats, etc. Hm, where's my data?

The words are not clear, but I think all the read track command will do is read the data from sectors. It might work; but if it only reads after valid IDs the results will still be nil.

It apparently continues to read, however, so it is worth a try. I am suspicious when it says it stops when the number of sectors on a track have all been read or that the command terminates if no valid ID mark between two index holes. The more I look at that chip the more I like my 17xx/27xx family of controllers. They're dumber, but I can do all kinds of magic with them.
<^_^>

A Cry for Help

s.100/general #100, from uncleroger (Roger Louis Sinesohn)

O.K. Here's the situation: I've got a box/P.S./motherboard, which just come out of a working system. I've got a CPU 88/85, a RAM-16, on Interfacer 1(+?), and a Morrow DJDMA. So for, so good. Well, I put in all the boards, connect the DJDMA (a disk controller card, BTW) to a working Shugart 801 (or 800?) 8" SSDD disk drive, and turn it all on. Nothing happens. I mean, the fans come on, and the power light goes on, and the drive starts spinning, etc., but the drive doesn't start ka-chunking or anything, and nothing happens on the terminal, etc.

So I change to different RAM cords.

Still no go. Different CPU. Still no go. The Interfacer I is new, as is the DJDMA.

Any suggestions? My only thought is that the DJDMA is bad. Could be. The jumpers on everything are set right. I can't figger out why it don't work. Arrggghhh!
Thanks in advance,

s.100/general #101, from w_smith
a comment to message 100

Well, if you are _absolutely_sure_ that all switches and jumpers are set right (On which board is the boot ROM active? Does the memory respond to Phantom properly? Is the CPU set up to jump to the proper address on reset? Is the disk drive set up and cabled properly? etc.), I would suggest taking your scope and looking at some of the basic S-100 lines to see what activity you have. Make sure you have all power lines within spec, the CPU is generating a clock signal, at least a few of the address and data lines are jumping around, and stuff like that.

One of the "problems" that I have with my 21-slot backplane is that if I spread the cards out (the logical way to load a cardcage), the timing or something gets off and the system will not work. Also,

be careful that only one card in the system is generating MWRT. The most important part of my S-100 system is ANSI/IEEE Std 696-1983, I think it cost maybe $10.

s.100/general #102, from uncleroger
a comment to message 101

Whoa! OK. As far as I know, all the jumpers & switches are set right. I will double-check them tonight. According to the DJDMA manual, it is supposed to load a bootstrap(?) program into the first bit of memory. (I don't have the manuals, or I'd check.) How do you tell if the memory responds to Phantom correctly? (I meant, I don't have the manuals here (at work).)

Scope? The closest thing I have is a multimeter. I checked all the important pins, like it says in the CompuPro enclosure manual, and they all checked out OK. Some of the ones that are supposed to have around 2-3 volts had zero, though. Which brings to mind active termination. I dunno if I got it or not.

I will try moving the cards around and closer together.

What is MWRT, and how can I check it without a scope? (I assume you mean an oscilloscope?) And what is an ANSI/IEEE Std 696-1983, and where can I get it?

PS. I'm not all that knowledgeable about the technical aspects. (That's why I'm still in school.)

s.100/general #104, from w_smith
a comment to message 102

Hmm, if you had the boards all out and checked the lines and none of the address and data lines had around 2-3 volts, that means you have no termination, active or passive. This might be bad, as I doubt any of the boards you mentioned would have terminators, and without termination, you might get some interesting ringing. See if there are rows of resistors (and possibly a couple transistors and such) at either end of the bus. MWRT is a memory write strobe that can be generated in any number of places, but must be limited to one and only one. Hmm, without a scope, you are just a bit hog-tied. I was going to suggest that you might get away with a logic probe, though that might be a pain. Also, as Joanne mentioned, the disk you are trying to boot from must be for your disk controller. Try turning off the power and moving the read/write head towards the center of the disk, then power it up and see if it seeks back to track 00.

As for the ANSI/IEEE Std 696-1983, that's the S-100 spec written up by the group that standardized it. I think it cost me about $10 or so. Get an order form from an issue of the IEEE Spectrum magazine (they list available publications every 6 months or so) or write:

The Institute of Electrical and Electronics Engineers
345 East 47th Street
New York, NY 10017

The spec will tell you everything you ever wanted to know about the S-100 bus. Note that this is also known as the IEEE-696 spec. Any board that meets this spec will work with any other board that meets the spec, but generic S-100 boards may not (most probably will, but there's no guarantee). Thus the larger S-100 companies are now all IEEE-696 compatible, whereas some of the little guys just sell S-100 boards. There may be some confusion about conformance vs. compatibility, but that's out of my league. I guess Joanne had the best idea, find yourself a guru with a scope. Then again, borrow a scope and make yourself into a guru!

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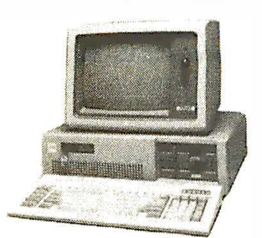
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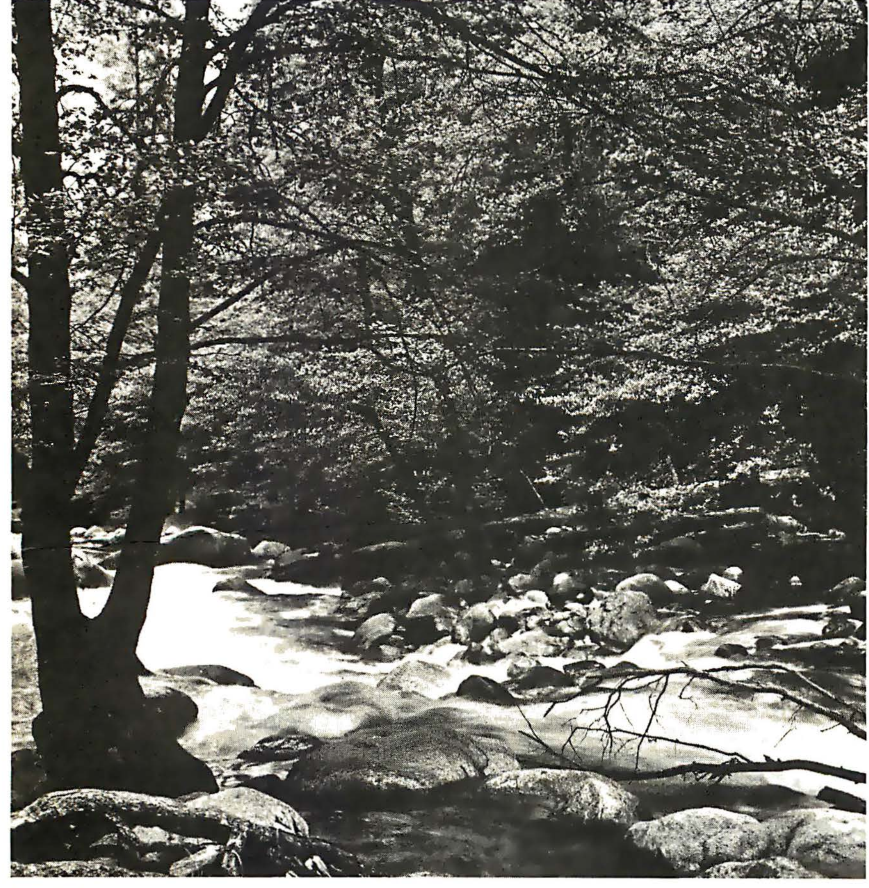
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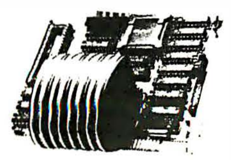
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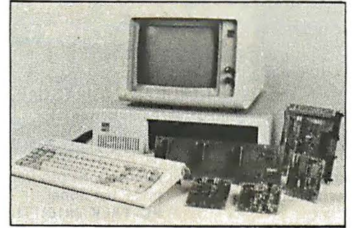


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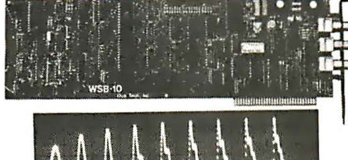
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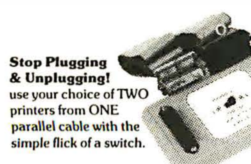
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PC TYPE (#455) Jim Button's contribution to a full fledged word processor.

SCREEN EDITORS

FOIL EDIT (#347) Full screen editor. Top to bottom and left to right.

TEXT PROCESSING TOOLS

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WORDSTAR AIDS (#379) collection of the most useful utilities for the Wordstar user.
PC OUTLINE (#414) Create and collapse and outline. Great for plans, essays, etc.

DATABASE PROGRAMS

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NEWBASE (#233) Menu driven database for the beginner.
PC-DBMS (#383) A relational database management system that provides on-line help and screen editing functions.
ELSIE EXPERT SYSTEM (#398) Artificial intelligence shell to build a custom knowledge-base.
PDS*BASE (#396) Complete hierarchical data base system master/detail or mother/daughter type.
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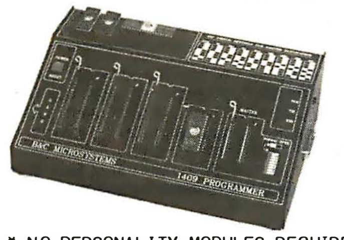
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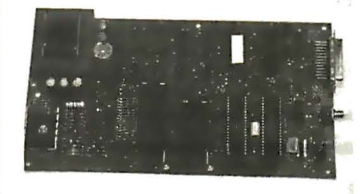
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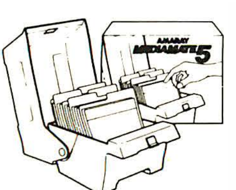
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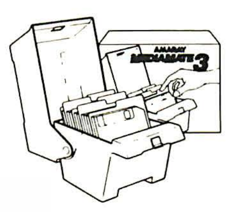
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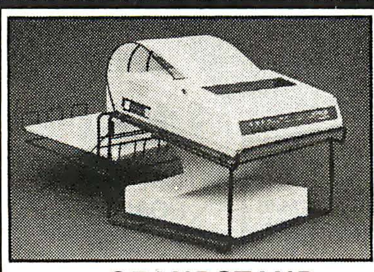
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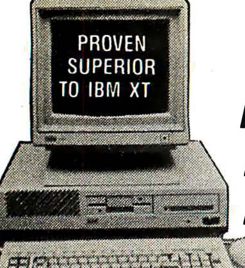


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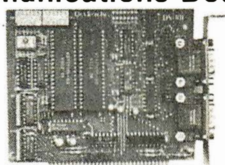
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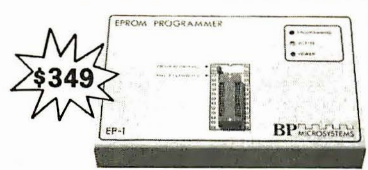
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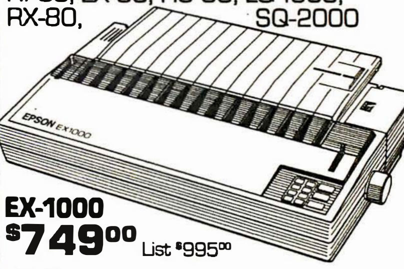
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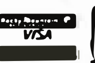
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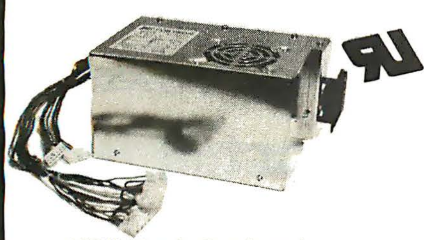
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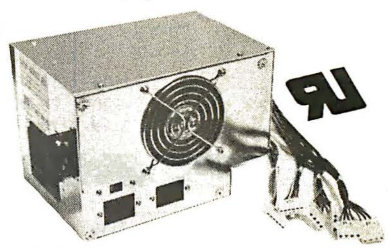


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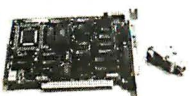
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PC/AT **$189.00**

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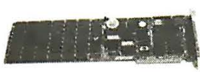
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- 80 x 25 text mode
- 720 x 348 graphic mode
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- Memory expansion to 384K
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- Serial, parallel ports
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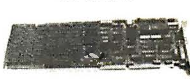
FC 740 Multi-I/O $109.00 w / Floppy Controller



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- Clock / calendar
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FC 1730 Multifunction Card for PC AT



- 1 EIA-RS232 port (2nd optional)
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- Expandable to 3 MB (optional) by piggy back board
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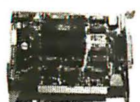
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FC 940 RS232 / Real Time Clock



- RS232C port
- To 9600 baud
- Battery back-up

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Hard Disk Controller for XT
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- WD WX-2 (Western Digital) .. $145.00
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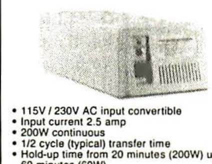
w / o printer port

w / printer port

EGA Monitor $459.00

- For PC / XT / AT and compatibles
- 256K on board memory
- Full 16 colors in 640 x 350 on IBM® enhanced color display
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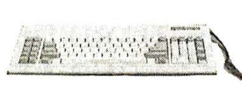
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- 115V / 230V AC input convertible
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- 5.12" x 7.7" x 13.46"

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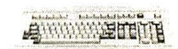
- IBM AT compatible keyboard
- Enlarge return key
- Light on num. lock key

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FC 427 (5150 Type) $79.00



FC 437 (5151 Type)



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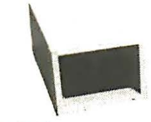
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- System interface adaptor included

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- System interface adaptor included

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- Capable of holding 2 half-height drives
- System interface adaptor included

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(w / controller, cable & tape)



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- 130 C.P.S.
- 80 columns
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Inquiry 114 for End-Users. Inquiry 115 for DEALERS ONLY.

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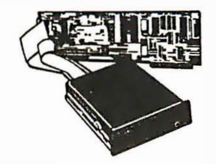
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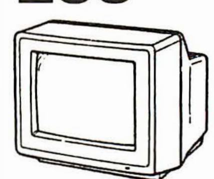
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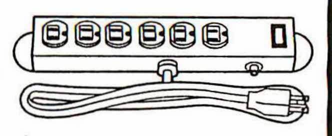
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- Tall Tree JRAM-3 2 MB — $599
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- AST Rampage-AT 2 MB — $749
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- Tecmar Graphics Master — $439
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- II+ 80 column card — $119
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JADE COMPUTER



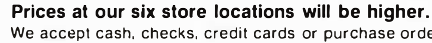
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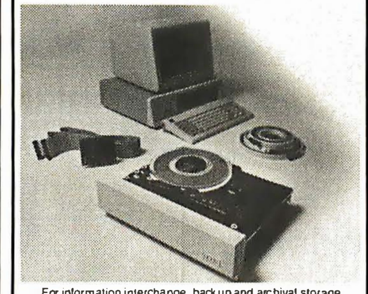


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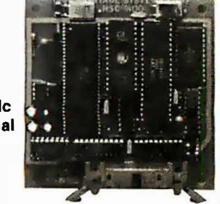
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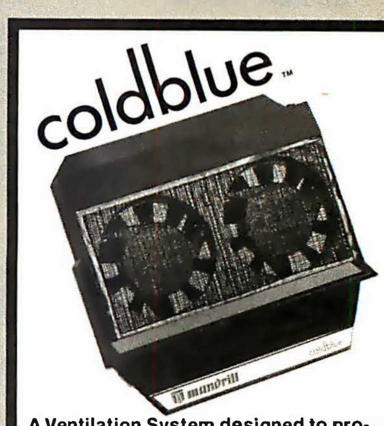
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HM6116 P	150ns	1.35	4164	150ns	.95
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Z-6132	300ns	19.89	41256	150ns	2.89
HM6164 P	150ns	3.35	41256	120ns	3.89
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EPROMS

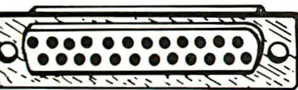
2516	450ns	2.95	2732 A	250ns	2.49
2532	350ns	3.75	2764	450ns	1.89
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2716-5	490ns	1.29	27128	250ns	2.69
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74LS01	.14	74LS126	.36	74LS266	.36
74LS02	.14	74LS132	.36	74LS273	.76
74LS03	.14	74LS133	.46	74LS275	1.96
74LS04	.14	74LS136	.36	74LS279	.36
74LS05	.16	74LS137	.98	74LS280	1.18
74LS08	.16	74LS138	.36	74LS283	.56
74LS09	.16	74LS139	.36	74LS290	.86
74LS10	.14	74LS145	.86	74LS293	.76
74LS11	.18	74LS147	.86	74LS295	.66
74LS12	.18	74LS148	.86	74LS298	.66
74LS13	.36	74LS151	.36	74LS299	1.46
74LS14	.24	74LS153	.36	74LS323	2.46
74LS15	.24	74LS154	1.46	74LS324	1.68
74LS20	.16	74LS155	.46	74LS352	1.24
74LS21	.20	74LS156	.46	74LS353	1.18
74LS22	.20	74LS157	.34	74LS363	1.28
74LS26	.20	74LS158	.28	74LS364	1.88
74LS27	.20	74LS160	.28	74LS365	.36
74LS28	.24	74LS161	.36	74LS366	.36
74LS30	.16	74LS162	.46	74LS367	.36
74LS32	.16	74LS163	.36	74LS368	.36
74LS33	.26	74LS164	.46	74LS373	.76
74LS37	.24	74LS165	.64	74LS374	.76
74LS38	.24	74LS166	.86	74LS377	.76
74LS40	.16	74LS168	.94	74LS378	1.12
74LS42	.36	74LS169	.94	74LS385	1.84
74LS47	.56	74LS170	.84	74LS386	.42
74LS48	.66	74LS173	.46	74LS390	1.06
74LS49	.66	74LS174	.36	74LS393	.76
74LS51	.16	74LS175	.36	74LS395	1.06
74LS54	.18	74LS181	1.46	74LS399	1.06
74LS55	.20	74LS189	3.86	74LS424	2.86
74LS63	.86	74LS190	.46	74LS447	.92
74LS73	.28	74LS191	.46	74LS490	1.46
74LS74	.22	74LS192	.66	74LS624	1.92
74LS75	.26	74LS193	.66	74LS640	.96
74LS76	.26	74LS194	.56	74LS645	.96
74LS78	.36	74LS195	.56	74LS668	1.46
74LS83	.46	74LS196	.56	74LS669	1.26
74LS85	.46	74LS197	.56	74LS670	.86
74LS86	.20	74LS221	.56	74LS674	9.58
74LS90	.36	74LS240	.66	74LS682	3.14
74LS91	.86	74LS241	.66	74LS683	2.86
74LS92	.46	74LS242	.66	74LS684	2.86
74LS93	.36	74LS243	.66	74LS685	2.86
74LS95	.46	74LS244	.58	74LS668	1.86
74LS96	.46	74LS245	.68	74LS689	2.86
74LS107	.32	74LS247	.68	74LS783	21.96
74LS109	.34	74LS248	.66	81LS95	1.36
74LS112	.26	74LS249	.96	81LS96	1.36
74LS113	.32	74LS251	.46	81LS97	1.36
74LS114	.32	74LS253	.46	81LS98	1.36
74LS122	.44	74LS257	.36		
74LS123	.46	74LS258	.46	25LS2521	2.48
74LS124	2.60	74LS259	1.18	25LS2569	2.48

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8100		8279-5	2.79
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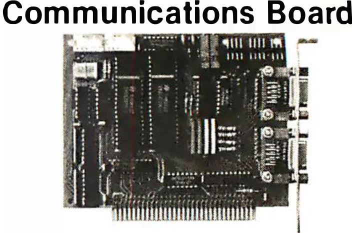
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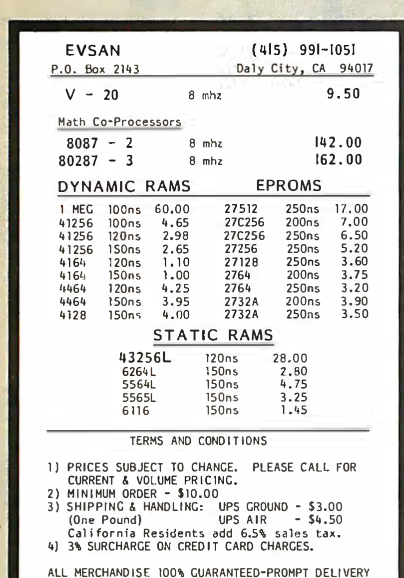
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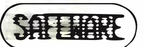
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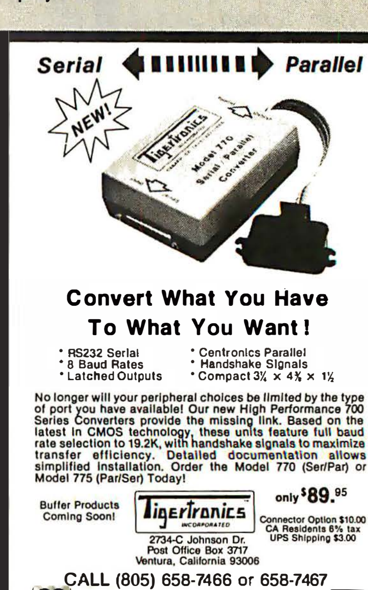
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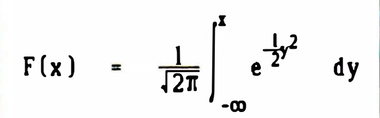
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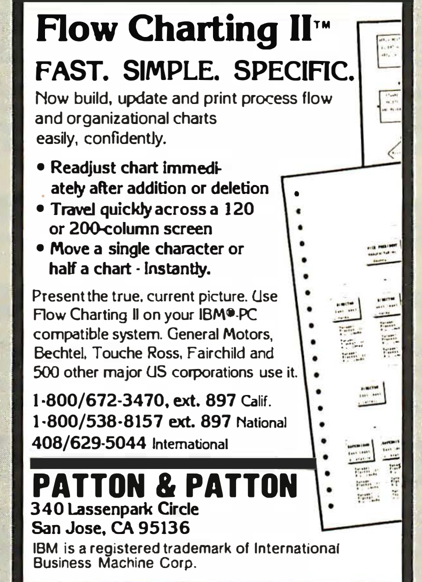
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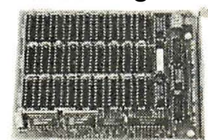
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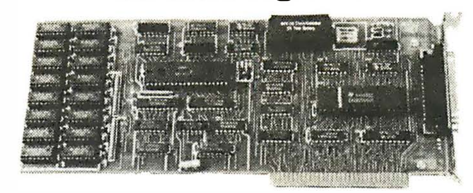


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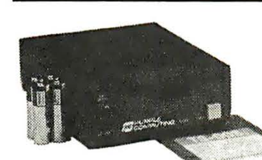
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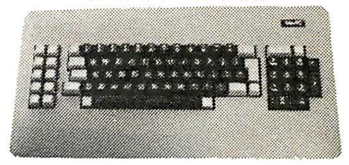
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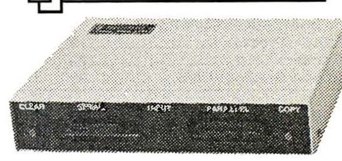
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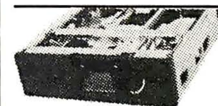
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IBM Compatible Computer



- 256K Expandable to 640K on Motherboard
- Double Sided Double Density Disk Drive
- IBM Type Keyboard (with LED indicators)
- Floppy Controller Card
- Eight Expansion Slots
- 135 Watt Power Supply

The Eclipse 16 is an outstanding value in IBM Compatible Computers. Aftercareful research and evaluation we found it to be the most reliable unit.

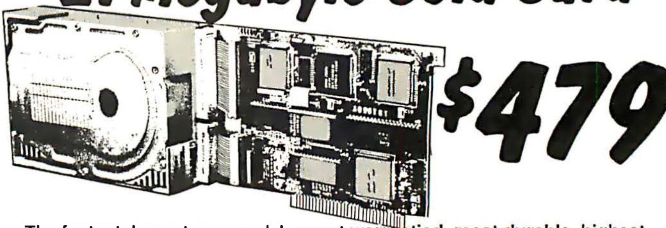
Our computer includes some of the newest features available, such as the 4.7MHz, multi-layer motherboard with 256K of RAM upgradable on board to 640K. A generous eight expansion slots and 135 Watt power supply give you ample room and power for add-on boards. The enclosure has an easy-access flip top lid making upgrades a breeze. And our floppy controller supports up to four drives, so as many as three additional drives can be used. Finally, each computer is configured and fully tested before sending it to you.

Satisfaction Guaranteed! We're really excited about this new unit, and so sure you will be too... that you may return the Eclipse 16 for a full credit towards an IBM PC if you are not completely satisfied.

OPTIONS

20MB Hard Drive w/Controller	$495	RGB Color Monitor	199
Additional Drive-Installed	99	TTL Monochrome Monitor	139
Irwin 10 Meg. Tape Back up	489	Microsoft Mouse	139
Upgrade from 256K to 640K RAM	79	Upgrade from Floppy Controller to Disk I/O 2 drive controller, clock/cal., software parallel, serial, and game ports	79
8087 Math Co Processor	119	1200 Baud Internal Modem w/Software	179
Color Graphics Card	79		
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21 Megabyte Gold Card



$479

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Omni-Reader... the first optical character reader **designed and priced for the small computer**

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Uses a standard RS-232 serial port hookup to interface eaisily with your computer.



1200 BAUD MODEMS

AVATEX 1200 $99



This 300/1200 baud modem matches the design specs of the Bell212A, feature by feature, bringing you reliability, impeccable transmission and easy operation. Hayes Compatible, except for "S" register. Communication software included.

The AVATEX 1200. at $99, is a steal!

SMARTEAM 1200 $159

The Team 212A offers all the features of the Hayes Smart Modem 1200 for a fraction of the price. Now is your opportunity to purchase a 1200 baud modem at the price of a 300 baud modem.

NEC RACKMOUNT MODEM $69



The NEC N212BR modem is designed for use in a rackmount configuration or may be used stand alone on external power. The Unit is fully 300/1200 Hayes compatible allowing for auto dial, auto log/on password capabilities. This modem is also switch selectable to the special NEC command set, which contain too many features to describe in this limited space.

The NEC212BR originally cost $595. California Digital has available 500 units which we are offering at only $69.

ECLIPSE 2400 BAUD MODEM $299



• Hayes & Bell 212A/103 Compatible
• CCITT V.22, V.22 bis

The ECLIPSE 2400 modem is a microprocessor-based full or half-duplex modem incorporating the latest in high speed data communications capabilities. It also accomodates computers and terminals equipped with an RS-232 port allowing communication with other computers ortimeshar ing systems either locally or remotely. Compatibility, Versitility and Performance are yours in a configuration designed to provide years of reliable operation.

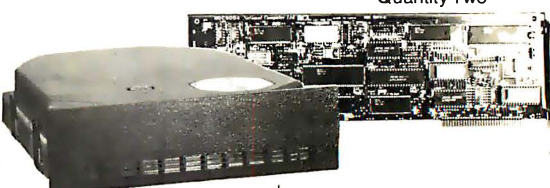
MODEMS

Eclipse 1200 100% Hayes, with status lamps.	EDP-1200	149.00
Eclipse 1200B internal with software	EDP-1200B	139.00
Eclipse 2400 External, Hayes Compatiple	EDP-2400	299.00
Avatex 1200 baud external, Hayes	AVA-1200	99.00
Hayes Smartmodem 2400 baud modem	HYS-2400	599.00
Fujitsu 2400/1200 baud auto everything.	FUJ-1935D	459.00
Team 1200 Hayes Compatible, 300/1200 baud.	TEM-1200	159.00
Smarteam 1200B IBM 1200 baud card	TEM-1200B	159.00
UltraLink 1200 data and voice on same line.	UTL-1200A	99.00
CTS 212AH 1200 baud, autodial	CTS-212AH	179.00
Terminal software for CTS 212AH	CTS-212SFT	35.00
Prometheus 1200 super features	PRM-P1200	289.00
Prometheus 1200B internal PC	PRM-P1200B	279.00
Signalman Mark VI, 300 baud internal PC	SGL-MK6	49.00
Hayes Smart Modem 1200 baud, auto dial	HYS-212AD	369.00
Hayes 1200B for use with the IBM/PC, 1200baud.	HYS-1200B	339.00
Hayes Chronograph, time & date	HYS-CHR232	199.00

Seagate $299

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Five Inch Winchester Disk Drives

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SEAGATE 225 20 Meg. ½ Ht.	329	299
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FUJITSU 2243 86 M. 35mS.	2095	2019
RODIME RO-202E 27 Meg.	659	629
RODIME RO-203E 40 Meg.	995	959
RODIME RO-204E 53 Meg.	995	959
CONTROL DATA 94155-86 M.	1829	1779
MAXTOR XT1140 140 Meg.	2995	2929
HONEYWELL 85M. 27 mS.	1795	1695
TOSHIBA MK56 70 M. 30mS.	1789	1729
TANDON 502 10 Meg.	419	379

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XEBEC 1220 with floppy controller	229
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DTC 5150BX	139
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ADAPTEC 2010A software install	189
WESTERN DIGITAL WD/1002	139

• SCSI/SASI Winchester Controllers •

XEBEC 1410A 5¼" foot print	219
OMTI 20L	119

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Winchester enclosure and supply	139
Dual 20/34 cable set	25
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CHERRY INFRARED KEYBOARD



$119

The Cherry Switch Infrared wireless 84 key keyboard designed for use with the IBM/PC and XT series computers. The keyboard operates similar to the remote tuner of modern televisions, and transmits 20 feet line of sight to the computers IR receiver.

This wireless keyboard is ideal for classroom demonstrations or for use with projection screen television monitors. Includes IR keyboard and receiver module. Manufacturers suggested list was $289 now available, while they last for only $119.

Bernoulli Box

was $3540 now only

$1595



The **Bernoulli Box** by Iomega, features 10 and 20 *megabyte* removable cartridges, and delivers reliability, expandability, transportability, security and speed in one versatile subsystem. It lets you transfer megabytes of information safely and swiftly for primary or backup storage. Or combine several software programs onto a single cartridge for easy switching from one to another.

Reliable... the Box has incredible resistance to shock and vibration completely eliminating the possility of head crash.

Expandable... grow at your own pace by adding inexpensive cartridges. When **security** is essential, don't lock up your system... just lock up the cartridges.

The Bernoulli Box delivers preformance that often exceeds the best of hard disk speed and the convenience of floppy disks. At these prices don't be caught wishing you had one after a loss of irreplacable data.

		List	Our Price
10+10 Meg.	**A2210H**	**$3450**	**1595**
20+20 Meg.	**A2220H**	**4540**	**2095**
Bootable Controller		**255**	**159**
10 Meg. Cartridge		**79**	**49**
20 Meg. Cartridge		**99**	**65**

PRINTERS

MATRIX PRINTERS

NEC/P7 132 col., par'l interface.	NEC-760	659.00
Star Gemini NL-15, 300 cps, 136 col. 24 wire head	STR-NB15	389.00
Star Gemini NX-10, 120 cps/30 cps NLQ, tractor	STR-NX10	359.00
Citizen MSP/10FT 160 char/sec.	CIT-MSP10	259.00
Panasonic KX1091 120 cps. draft, 29 NLQ tract& friction.	PAN-KX1091	259.00
Toshiba 351 P/S, 240 char/sec. 24 wire head	TOS-351PS	1099.00
Toshiba 341 PS/E parl. 180 cps. 24 wire head	TOS-341PSE	759.00
Okidata 182P/IBM parallel 9½" paper	OKI-182P	239.00
Okidata 192A parallel interface, 160 char/sec.	OKI-192A	379.00
Okidata 84P parallel 15" paper	OKI-84P	695.00
Epson LX-80 10" 120 Char/sec.	EPS-LX80	259.00
Epson LQ800 near letter quality	EPS-LQ800	629.00
Epson FX85 160 cps. draft 32 cps. NLQ, 240 dot/inch.	EPS-FX85	399.00
Epson FX286 132 col., 200 cps. 29 cps NLQ, graphics.	EPS-FX286	599.00
Dataproducts B-600-3, band printer 600 LPM.	DPS-B600	6985.00
Printronix P300 high speed printer 300 lines per minute.	PTX-P300	3995.00
Printronix P600 ultra high speed 600 lines per minute.	PTX-P600	5795.00

WORD PROCESSING PRINTERS

Starwriter F10 (6400) parallel, 40 char/sec.	PRO-F10P	429.00
Same as above but 55 char/sec., 50 pin Diablo interface	PRO-F55P	559.00
NEC8810 55 char/second, serial interface	NEC-8810	1179.00
NEC8830 55 char/sec, par'l interface.	NEC-8830	1179.00
NEC3550 popular printer designed for the IBM/PC	NEC-3550	819.00
Silver Reed EXP600, 25 cps. 10/12/15 pitch. serial/par'l.	SRD-EXP600	319.00
Silver Reed EXP800 same as 600 but 40 char/sec.	SRD-EXP800	729.00
Diablo 620, proportional spacing, horz.& vert. tab. 20 cps.	DBL-620	299.00
Juki 6100, 18 char./sec.	JUK-6100	359.00
Juki 6300, 40 char./sec.	JUK-6300	689.00

Quick-Link 300



$59

The Quick-Link 300 gives you an instant link to any dial up database. Such as Dow Jones, Western Union or the Source. The Quick-Link has four user programmable log-on keys, allowing the operator, with only one key stroke, to dial the data base, log-in and give the password. All this information is permanently stored in non-volatile RAM.

Features include video output to television or monitor, auto dial, auto-log, full sized keyboard, 300 baud modem and 1200 baud auxillary printer port. All this is available for only $59.

FOUR PEN COLOR PLOTTER

$159

The manufacturer has asked us not to publish their name. But this four color plotter was produced by one of the Worlds largest makers of personal computers.

The 410 color plotter will connect to the serial port of virtually any micro-computer. Simple ASCII commands direct one of the four color pens to draw circles, arcs or ellipses on paper or transparency material up to 11 by 17 inches. The plotter is capable of producing the full upper and lower case alphabet along with seven international character sets. Text can be printed horizotal, vertical or diagonal in sizes from 1/16 to 6 inches, slanted forward or backward to 85 degrees.

Enlargements or reductions are achieved through elaborate firmware. Pen travel is four inches per second with .004" pen resolution. Standard pens are available in an assortment of 32 different colors and widths.

The ideal plotter for architecture, CAD engineering or graphic design. **At $595 it was a great buy, at $159 its a steal.** Support packages for specific computers available. Manual only $15 refundable upon purchase or plotter.

Sweet P 100 Plotter

$159

The Sweet "P" 100 was private labeled for the Epson corporation under the Comrex Brand. This plotter makes short work of translating financial and numeric data into a graphic presentation. Many ready to run programs such as Auto/CAD, Lotus 1-2-3, and Visi-on already support this plotter.

The Sweet "P" 100 features programmable paper sizes up to 8½ by 120 inches, 6 inch per second plot speed and 0.004" step size. Easy to implement Centronics interface allows the Sweet "P" 100 immediate use with the printer port of most personal computers.

Also available is a support package which includes demonstration software, interface cable, a multicolor pen assortment and a variety of paper and transparency material.

PLOTTERS

Four pen color plotter, 11 by 17 IBM/PC compatible	APL-410	$159
Sweet "P" 100 (Comrex) 8½ by 120"	COM-C1	$159
Houston Instruments DMP29, 11 by 17	HOU-29	1779
Houston Instruments DMP40, 11 by 17, B size	HOU-40	959
Houston Instruments DMP41/42 C/D 24 by 36	HOU-41	3779
Houston Inst. DMP51/52MP C/D, 14 pen plotting	HOU-51MP	4859
Houston Instruments DMP56, E size 34 by 44	HOU-56	4795
Houston Instruments PC695, 11 by 17 multi-pen	HOU-695	579
Roland DYX-101 flat bed 11 by 17	ROL-101	419
Roland DYX-800 11 by 17 multi-pen 8 color	ROL-800	899
CalComp 1043GT plotter	CCP-1043	7899

DIGITIZERS • MOUSE

Hitachi Tiger Tablet 11 by 11"	HIT-TT2	615
Summagraghics Summasketch 12" four button	SUM-SK12	399
Summagraphics SummaMouse 100 line resolution	SUM-MS	99
MicroSoft serial mouse with paint brush	MST-MS232	139
MicroSoft bus mouse card w/paint brush	MST-MSB	129

F/10 Daisy Wheel Printer

$429

The TEC F-10 Daisy Wheel printer is the perfect answer to a reasonablly priced 40 character word processing printer. While this printer is identical to C.Itoh's F-10/40 Starwriter printer, it bears the name of a well known computer manufacturer.

This 40 character per second printer auto installs with Wordstar and Perfect Writer. Features extensive built-in word processing functions that allow easy adaptability and reduced software complexity. Industry standard Centronics interface provides instant compatibility with all computers equiped with a parallel printer port. The TEC F-10 accepts paper up to 15 inches in width.

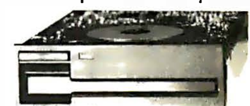
These printers were originally priced to sell at over $1400. Through a special arrangment California Digital has purchase these units from the computer manufacturer and is offering these printers at a fraction of their original cost.

Options available include sheetfeeder, tractor feed, buffered memory and an assortment of printer cables for a variety of computers.

SONY 53W Floppy Disk Drive

3 1/2" New IBM portable compatible

$139



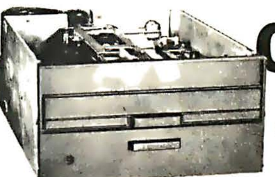
5¼" DISK DRIVE



$89

Quantity Two

	One	Two	Ten
TEAC FD55BV half height	**109**	**99**	**89**
TEAC FD55FV 96 TPI, half ht.	**119**	**109**	**105**
TEAC FD55GF for IBM AT	**169**	**159**	**155**
PANASONIC 455 Half Height	**109**	**99**	**89**
PANASONIC 465 ½ Ht. 96TPI	**139**	**129**	**125**
TANDON 100-2 full height	**129**	**125**	**119**
MITSUBISHI new 501 half ht.	**129**	**119**	**109**
MITSUBISHI 504A AT comp.	**169**	**159**	**155**
QUME 142 half height	**99**	**89**	**89**
Switching power supply			**49**
Installation Kit with manual			**10**
Dual enclosure for 5¼" drives			**59**
34 pin edge connectors			**5**
Scotch head cleaning kit			**19**
Flip & File Storage tubs			**15**



QUME $119

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QUME 841 single side	**129**	**119**	**call**
SHUGART 801R	**359**	**359**	**354**
SIEMENS FDD 100-8	**119**	**115**	**109**
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QUME 842 "QUME TRACK 8"	**189**	**179**	**call**
SHUGART SA851R	**495**	**485**	**475**
OLIVETTI double sided	**189**	**179**	**159**
REMEX RFD-4000	**179**	**169**	**159**
MITSUBISHI M2896-63 ½ Ht.	**459**	**449**	**409**
Dual 8" enclosure with power and fan			**259**
Switching power supply			**89**
Installation kit with manual			**10**

Adeus Daisy Wheel

$159



The Adeus CP/2000, is a 22 character per second daisy wheel printer which accepts 96 character Diablo wheels and ribbons. This printer was manufactured by the Olympia Typewritter Company for Cosmo World USA.

This unit will print 10, 12 and 15 characters per inch proportionally spaced with increments of 1/120". Bi-directional printing, 2 K/Byte buffer (expandable to 6K) and both serial and Centronics parallel interfacing make the Adeus CP/2000 an exceptional buy at only $159. Original price $595.



Shipping: First five pounds $3.00, each additional pound $.50.
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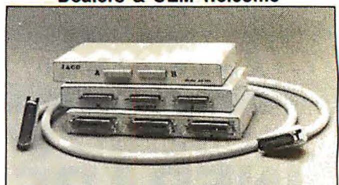


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Break-out box	$59

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RS232 Cable (male to male)	6'/10'	$12/$14
RS232 Cable (male to female)	3'/6'/10'/12'	$10/$12/$14/$16
(25 line connected can be used as modem or extension)		
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8K RAM CHIP*—Model-100* ***$23*** *and NEC 8201 . . . 3 or more/$19 ea.*

SIDESTAR*—NEC Starlet ~~$899~~* ***$199***
128K Ram Disk Cartridge

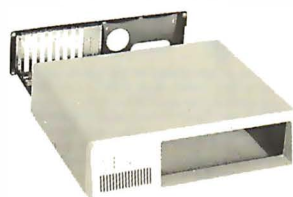
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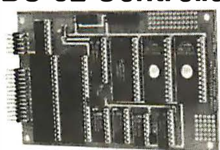
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		MONITOR COLOR 640x400	$338
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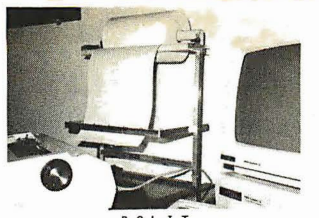
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Printer Cable	$ 2.95

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(213) 477-0447
(714) 731-5727
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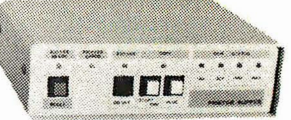
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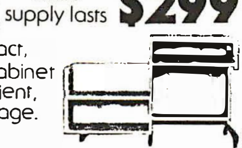
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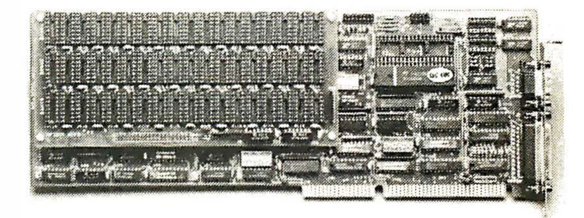
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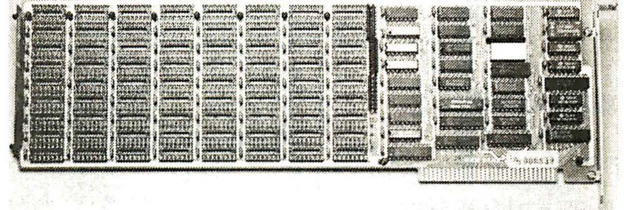


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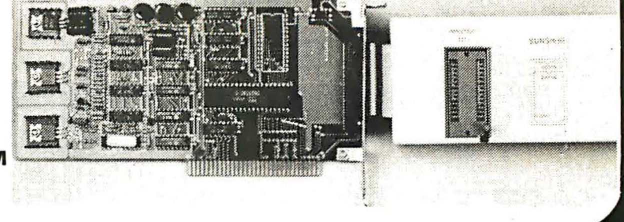
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2112	256x4	(450ns)	2.99
2114	1024x4	(450ns)	.99
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2114L-2	1024x4	(200ns)(LP)	1.49
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TMM2016-150	2048x8	(150ns)	1.49
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HM6116LP-3	2048x8	(150ns)(CMOS)(LP)	2.05
HM6116LP-2	2048x8	(120ns)(CMOS)(LP)	2.95
HM6264P-15	8192x8	(150ns)(CMOS)	3.89
HM6264LP-15	8192x8	(150ns)(CMOS)(LP)	3.95
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LP=Low power

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4116-200	16384x1	(200ns)	.89
4116-150	16384x1	(150ns)	.99
4116-120	16384x1	(120ns)	1.49
MK4332	32768x1	(200ns)	6.95
4164-200	65536x1	(200ns)(5v)	1.19
4164-150	65536x1	(150ns)(5v)	1.29
4164-120	65536x1	(120ns)(5v)	1.95
MCM6665	65536x1	(200ns)(5v)	1.95
TMS4164	65536x1	(150ns)(5v)	1.95
4164-REFRESH	65536x1	(150ns)(5V)(REFRESH)	2.95
TMS4416	16384x4	(150ns)(5v)	4.95
41128-150	131072x1	(150ns)(5v)	5.95
TMS4464-15	65536x4	(150ns)(5v)	6.95
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5v=Single 5 Volt Supply   REFRESH=Pin 1 Refresh

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TMS2532	4096x8	(450ns)(5V)	5.95
2732	4096x8	(450ns)(5V)	3.95
2732A	4096x8	(250ns)(5V)(21V PGM)	3.95
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2764	8192x8	(450ns)(5V)	3.49
2764-250	8192x8	(250ns)(5V)	3.95
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27128	16384x8	(250ns)(5V)	4.25
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27256	32768x8	(250ns)(5V)	7.49

5V=Single 5 Volt Supply   21V PGM=Program at 21 Volts

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Model	Timer	Capacity Chip	Intensity (uW/Cm²)	Unit Price
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PE-24T	YES	12	9,600	$175.00

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8039	1.95
8080	2.95
8085	2.49
8087-2	169.95
8087	129.00
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8088-2	9.95
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8155-2	3.95
8748	7.95
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8203	24.95
8205	3.29
8212	1.49
8216	1.49
8224	2.25
8237	4.95
8237-5	5.49
8250	6.95
8251	1.69
8251A	1.89
8253	1.89
8253-5	1.95
8255	1.69
8255-5	1.89
8259	1.95
8259-5	2.29
8272	4.95
8279	2.49
8279-5	2.95
8282	3.95
8284	2.95
8286	3.95
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68B09	6.95
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4.0	1.95
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5.0688	1.95
6.0	1.95
6.144	1.95
6.5536	1.95
8.0	1.95
10.0	1.95
10.738635	1.95
12.0	1.95
14.31818	1.95
15.0	1.95
16.0	1.95
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2.5	4.95
4.0	4.95
5.0688	4.95
6.0	4.95
6.144	4.95
8.0	4.95
10.0	4.95
12.0	4.95
12.480	4.95
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18.432	4.95
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74LS01	.18	74LS166	.95
74LS02	.17	74LS169	.95
74LS03	.18	74LS173	.49
74LS04	.16	74LS174	.39
74LS05	.18	74LS175	.39
74LS08	.18	74LS191	.49
74LS09	.18	74LS192	.69
74LS10	.16	74LS193	.69
74LS11	.22	74LS194	.69
74LS12	.22	74LS195	.69
74LS13	.26	74LS196	.59
74LS14	.39	74LS197	.59
74LS15	.26	74LS221	.59
74LS20	.17	74LS240	.69
74LS21	.22	74LS241	.69
74LS22	.22	74LS242	.69
74LS27	.23	74LS243	.69
74LS28	.26	74LS244	.69
74LS30	.17	74LS245	.79
74LS32	.18	74LS251	.49
74LS33	.28	74LS253	.49
74LS37	.26	74LS256	1.79
74LS38	.26	74LS257	.39
74LS42	.39	74LS258	.49
74LS47	.75	74LS259	1.29
74LS48	.85	74LS260	.49
74LS51	.17	74LS266	.39
74LS73	.29	74LS273	.79
74LS74	.24	74LS279	.39
74LS75	.29	74LS280	1.98
74LS76	.29	74LS283	.59
74LS83	.49	74LS290	.89
74LS85	.49	74LS293	.89
74LS86	.22	74LS299	1.49
74LS90	.39	74LS322	3.95
74LS92	.49	74LS323	2.49
74LS93	.39	74LS364	1.95
74LS95	.49	74LS365	.39
74LS107	.34	74LS367	.39
74LS109	.36	74LS368	.39
74LS112	.29	74LS373	.79
74LS122	.45	74LS374	.79
74LS123	.49	74LS375	.95
74LS124	2.75	74LS377	.79
74LS125	.39	74LS378	1.18
74LS126	.39	74LS390	1.19
74LS132	.39	74LS393	.79
74LS133	.49	74LS541	1.49
74LS136	.39	74LS624	1.95
74LS138	.39	74LS640	.99
74LS139	.39	74LS645	.99
74LS145	.99	74LS669	1.29
74LS147	.99	74LS670	.89
74LS148	.99	74LS682	3.20
74LS151	.39	74LS683	3.20
74LS153	.39	74LS684	3.20
74LS154	1.49	74LS688	2.40
74LS155	.59	74LS783	22.95
74LS156	.49	81LS95	1.49
74LS157	.35	81LS96	1.49
74LS158	.29	81LS97	1.49
74LS160	.29	81LS98	1.49
74LS161	.39	25LS2521	2.80
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74LS163	.39	26LS31	1.95
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74HC: Operate at CMOS logic levels and are ideal for new, all-CMOS designs.

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74HC08	.59	74HC157	.89
74HC10	.59	74HC158	.95
74HC14	.79	74HC163	1.15
74HC20	.59	74HC175	.99
74HC27	.59	74HC240	1.89
74HC30	.59	74HC244	1.89
74HC32	.69	74HC245	1.89
74HC51	.59	74HC257	.85
74HC74	.75	74HC259	1.39
74HC85	1.35	74HC273	1.89
74HC86	.69	74HC299	4.99
74HC93	1.19	74HC368	.99
74HC107	.79	74HC373	2.29
74HC109	.79	74HC374	2.29
74HC112	.79	74HC390	1.39
74HC125	1.19	74HC393	1.39
74HC132	1.19	74HC4017	1.99
74HC133	.69	74HC4020	1.39
74HC138	.99	74HC4049	.89
74HC139	.99	74HC4050	.89

74HCT00

74HCT: Direct, drop-in replacements for LS TTL and can be intermixed with 74LS in the same circuit.

74HCT00	.69	74HCT166	3.05
74HCT02	.69	74HCT174	1.09
74HCT04	.69	74HCT193	1.39
74HCT08	.69	74HCT194	1.19
74HCT10	.69	74HCT240	2.19
74HCT11	.69	74HCT241	2.19
74HCT27	.69	74HCT244	2.19
74HCT30	.69	74HCT245	2.19
74HCT32	.79	74HCT257	.99
74HCT74	.85	74HCT259	1.59
74HCT75	.95	74HCT273	2.09
74HCT138	1.15	74HCT367	1.09
74HCT139	1.15	74HCT373	2.49
74HCT154	2.99	74HCT374	2.49
74HCT157	.99	74HCT393	1.59
74HCT158	.99	74HCT4017	2.19
74HCT161	1.29	74HCT4040	1.59
74HCT164	1.39	74HCT4060	1.49

74F00

74F00	.69	74F74	.79	74F251	1.69
74F02	.69	74F86	.99	74F253	1.69
74F04	.79	74F138	1.69	74F257	1.69
74F08	.69	74F139	1.69	74F280	1.79
74F10	.69	74F157	1.69	74F283	3.95
74F32	.69	74F240	3.29	74F373	4.29
74F64	.89	74F244	3.29	74F374	4.29

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 Inquiry 151

20MB HARD DISK SYSTEM ONLY $389.95!

CMOS

4001	.19	14419	4.95
4011	.19	14433	14.95
4012	.25	4503	.49
4013	.35	4511	.69
4015	.29	4516	.79
4016	.29	4518	.85
4017	.49	4522	.79
4018	.69	4526	.79
4020	.59	4527	1.95
4021	.69	4528	.79
4024	.49	4529	2.95
4025	.25	4532	1.95
4027	.39	4538	.95
4028	.65	4541	1.29
4035	.69	4553	5.79
4040	.69	4585	.75
4041	.75	4702	12.95
4042	.59	74C00	.29
4043	.85	74C14	.59
4044	.69	74C74	.59
4045	1.98	74C83	1.95
4046	.69	74C85	1.49
4047	.69	74C95	.99
4049	.29	74C150	5.75
4050	.29	74C151	2.25
4051	.69	74C161	.99
4052	.69	74C163	.99
4053	.69	74C164	1.39
4056	2.19	74C192	1.49
4060	.69	74C193	1.49
4066	.29	74C221	2.49
4069	.19	74C240	1.89
4076	.59	74C244	1.89
4077	.29	74C374	1.99
4081	.22	74C905	10.95
4085	.79	74C911	8.95
4086	.89	74C917	12.95
4093	.49	74C922	4.49
4094	2.49	74C923	4.95
14411	9.95	74C926	7.95
14412	6.95	80C97	.95

7400/9000

7400	.19	74147	2.49
7402	.19	74148	1.20
7404	.19	74150	1.35
7406	.29	74151	.55
7407	.29	74153	.55
7408	.24	74154	1.49
7410	.19	74155	.75
7411	.25	74157	.55
7414	.49	74159	1.65
7416	.25	74161	.69
7417	.25	74163	.69
7420	.19	74164	.85
7423	.29	74165	.85
7430	.19	74166	1.00
7432	.29	74175	.89
7438	.29	74177	.75
7442	.49	74178	1.15
7445	.69	74181	2.25
7447	.89	74182	.75
7470	.35	74184	2.00
7473	.34	74191	1.15
7474	.33	74192	.79
7475	.45	74194	.85
7476	.35	74196	.79
7483	.50	74197	.75
7485	.59	74199	1.35
7486	.35	74221	1.35
7489	2.15	74246	1.35
7490	.39	74247	1.25
7492	.50	74248	1.85
7493	.35	74249	1.95
7495	.55	74251	.75
7497	2.75	74265	1.35
74100	2.29	74273	1.95
74121	.29	74278	3.11
74123	.49	74367	.65
74125	.45	74368	.65
74141	.65	9368	3.95
74143	5.95	9602	1.50
74144	2.95	9637	2.95
74145	.60	96S02	1.95

74S00

74S00	.29	74S163	1.29
74S02	.29	74S168	3.95
74S03	.29	74S174	.79
74S04	.29	74S175	.79
74S05	.29	74S188	1.95
74S08	.35	74S189	1.95
74S10	.29	74S195	1.49
74S15	.49	74S196	2.49
74S30	.29	74S197	2.95
74S32	.35	74S226	3.99
74S37	.69	74S240	1.49
74S38	.69	74S241	1.49
74S74	.49	74S244	1.49
74S85	.95	74S257	.79
74S86	.35	74S253	.79
74S112	.50	74S258	.95
74S124	2.75	74S280	1.95
74S138	.79	74S287	1.69
74S140	.55	74S288	1.69
74S151	.79	74S299	2.95
74S153	.79	74S373	1.69
74S157	.79	74S374	1.69
74S158	.95	74S471	4.95
74S161	1.29	74S571	2.95

VOLTAGE REGULATORS

TO-220 CASE

7805T	.49	7905T	.59
7808T	.49	7908T	.59
7812T	.49	7912T	.59
7815T	.49	7915T	.59

TO-3 CASE

7805K	1.59	7905K	1.69
7812K	1.39	7912K	1.49

TO-93 CASE

78L05	.49	79L05	.69
78L12	.49	79L12	1.49

OTHER VOLTAGE REGS

LM323K	5V	3A	TO-3	4.79
LM328K	Adj.	5A	TO-3	3.95
78H05K	5V	5A	TO-3	7.95
78H12K	12V	5A	TO-3	8.95
78P05K	5V	10A	TO-3	14.95

LINEAR

TL066	.99	LM733	.98
TL071	.69	LM741	.29
TL072	1.09	LM747	.69
TL074	1.95	LM748	.59
TL081	.59	MC1330	1.69
TL082	.99	MC1350	1.19
TL084	1.49	MC1372	6.95
LM301	.34	LM1414	1.59
LM309K	1.25	LM1458	.49
LM311	.59	LM1488	.49
LM311H	.89	LM1489	.49
LM317K	3.49	LM1496	.85
LM317T	.95	LM1812	8.25
LM318	1.49	LM1889	1.95
LM319	1.25	ULN2003	.79
LM320	see 7900	XR2206	3.95
LM322	1.95	XR2211	2.95
LM323K	4.79	XR2240	1.95
LM324	.49	MPQ2907	1.95
LM331	3.95	LM2917	1.95
LM334	1.19	CA3046	.89
LM335	1.79	CA3081	.99
LM336	1.75	CA3082	.99
LM337K	3.95	CA3086	.80
LM338K	6.95	CA3089	1.95
LM339	.59	CA3130E	.99
LM340	see 7800	CA3146	1.29
LM350T	4.60	CA3160	1.19
LF353	.59	MC3470	1.95
LF356	.99	MC3480	8.95
LF357	.99	MC3487	2.95
LM358	.59	LM3900	.49
LM380	.89	LM3909	.98
LM383	1.95	LM3911	2.25
LM386	.89	LM3914	2.39
LM393	.45	MC4024	3.49
LM394H	5.95	MC4044	3.99
TL494	4.20	RC4136	1.25
TL497	3.25	RC4558	.69
NE555	.29	LM13600	1.49
NE556	.49	75107	1.49
NE558	1.29	75110	1.95
NE564	1.95	75150	1.95
LM565	.95	75154	1.95
LM566	1.49	75188	1.25
LM567	.79	75189	1.25
NE570	2.95	75451	.39
NE590	2.50	75452	.39
NE592	.98	75453	.39
LM710	.75	75477	1.29
LM723	.49	75492	.79

H=TO-5 CAN, K=TO-3, T=TO-220

DATA ACQ

ADC0800	15.55
ADC0804	3.49
ADC0809	4.49
ADC0816	14.95
ADC0817	9.95
ADC0831	8.95
DAC0800	4.49
DAC0806	1.95
DAC0808	2.95
DAC1020	8.25
DAC1022	5.95
MC1408L8	2.95

INTERFACE

8T26	1.29
8T28	1.29
8T95	.89
8T96	.89
8T97	.59
8T98	.89
DM8131	2.95
DP8304	2.29
DS8833	2.25
DS8835	1.99
DS8836	.99
DS8837	1.65

IC SOCKETS

	1-99	100+
8 PIN ST	.11	.10
14 PIN ST	.11	.09
16 PIN ST	.12	.10
18 PIN ST	.15	.13
20 PIN ST	.18	.15
22 PIN ST	.15	.12
24 PIN ST	.20	.15
28 PIN ST	.22	.16
40 PIN ST	.30	.22
64 PIN ST	1.95	1.49
ST=SOLDERTAIL		
8 PIN WW	.59	.69
14 PIN WW	.69	.52
16 PIN WW	.69	.58
18 PIN WW	.99	.90
20 PIN WW	1.09	.98
22 PIN WW	1.39	1.28
24 PIN WW	1.49	1.35
28 PIN WW	1.69	1.49
40 PIN WW	1.99	1.80
WW=WIREWRAP		
16 PIN ZIF	4.95	CALL
24 PIN ZIF	5.95	CALL
28 PIN ZIF	6.95	CALL
40 PIN ZIF	9.95	CALL

ZIF=TEXTOOL (ZERO INSERTION FORCE)

EDGECARD CONNECTORS

100 PIN ST	S-100	.125	3.95
100 PIN WW	S-100	.125	4.95
62 PIN ST	IBM PC	.100	1.95
50 PIN ST	APPLE	.100	2.95
44 PIN ST	STD	.156	1.95
44 PIN WW	STD	.156	4.95

36 PIN CENTRONICS

MALE

IDCEN36	RIBBON CABLE	6.95
CEN36	SOLDER CUP	4.95

FEMALE

IDCEN36/F	RIBBON CABLE	7.95
CEN36PC	RT ANGLE PC MOUNT	4.95

INTERSIL

ICL7106	9.95
ICL7107	12.95
ICL7660	2.95
ICL8038	4.95
ICM7207A	5.95
ICM7208	15.95

DIP CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS 8	14	16	18	20	22	24	28	40
HIGH RELIABILITY TOOLED ST IC SOCKETS	AUGATxxST	.62	.79	.89	1.09	1.29	1.39	1.49	1.69	2.49
HIGH RELIABILITY TOOLED WW IC SOCKETS	AUGATxxWW	1.30	1.80	2.10	2.40	2.50	2.90	3.15	3.70	5.40
COMPONENT CARRIES (DIP HEADERS)	ICCxx	.49	.59	.69	.99	.99	.99	.99	1.09	1.49
RIBBON CABLE DIP PLUGS (IDC)	IDPxx	---	.95	.95	---	---	---	1.75	---	2.95

FOR ORDERING INSTRUCTIONS SEE D-SUBMINIATURE BELOW

ICC16

IDP14

AUGAT 24ST

DIODES/OPTO/TRANSISTORS

1N751	.25	4N26	.69
1N759	.25	4N27	.69
1N4148	25/1.00	4N28	.69
1N4004	10/1.00	4N33	.89
1N5402	.25	4N37	1.19
KBP04	.55	MCT-2	.59
KBU8A	.95	MCT-6	1.29
MDA990-2	.35	TIL-111	.99
N2222	.25	2N3906	.10
PN2222	.10	2N4401	.25
2N2905	.50	2N4402	.25
2N2907	.25	2N4403	.25
2N3055	.79	2N6045	1.75
2N3904	.10	TIP31	.49

D-SUBMINIATURE

DESCRIPTION		ORDER BY	CONTACTS 9	15	19	25	37	50
SOLDER CUP	MALE	DBxxP	.82	.90	1.25	1.25	1.80	3.48
	FEMALE	DBxxS	.95	1.15	1.50	1.50	2.35	4.32
RIGHT ANGLE PC SOLDER	MALE	DBxxPR	1.20	1.49	---	1.95	2.65	---
	FEMALE	DBxxSR	1.25	1.55	---	2.00	2.79	---
WIRE WRAP	MALE	DBxxPWW	1.69	2.56	---	3.89	5.60	---
	FEMALE	DBxxSWW	2.76	4.27	---	6.84	9.95	---
IDC RIBBON CABLE	MALE	IDBxxP	2.70	2.95	---	3.98	5.70	---
	FEMALE	IDBxxS	2.92	3.20	---	4.33	6.76	---
HOODS	METAL	MHOODxx	1.25	1.25	1.30	1.30	---	---
	GREY	HOODxx	.65	.65	---	.65	.75	.95

ORDERING INSTRUCTIONS: INSERT THE NUMBER OF CONTACTS IN THE POSITION MARKED "xx" OF THE "ORDER BY" PART NUMBER LISTED.

EXAMPLE: A 15 PIN RIGHT ANGLE MALE PC SOLDER WOULD BE DB15PR.

MOUNTING HARDWARE $1.00

MTG HDWR

HOOD25

DB37S

IDB37S

LED DISPLAYS

FND-357(359)	COM CATHODE	.362"		1.25
FND-500(503)	COM CATHODE	.5"		1.49
FND-507(510)	COM ANODE	.5"		1.49
MAN-72	COM ANODE	.3"		.99
MAN-74	COM CATHODE	.3"		.99
MAN-8940	COM CATHODE	.8"		1.99
TIL-313	COM CATHODE	.3"		.45
HP5082-7760	COM CATHODE	.43"		1.29
TIL-311	4x7 HEX W/LOGIC	.270"		9.95
HP5082-7340	4x7 HEX W/LOGIC	.290"		7.95

DIFFUSED LEDS

		1-99	100-UP
JUMBO RED	T1¾	.10	.09
JUMBO GREEN	T1¾	.14	.12
JUMBO YELLOW	T1¾	.14	.12
MOUNTING HDW	T1¾	.10	.09
MINI RED	T1	.10	.09

IDC CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS 10	20	26	34	40	50
SOLDER HEADER	IDHxxS	.82	1.29	1.68	2.20	2.58	3.24
RIGHT ANGLE SOLDER HEADER	IDHxxSR	.85	1.35	1.76	2.31	2.72	3.39
WW HEADER	IDHxxW	1.86	2.98	3.84	4.50	5.28	6.63
RIGHT ANGLE WW HEADER	IDHxxWR	2.05	3.28	4.22	4.45	4.80	7.30
RIBBON HEADER SOCKET	IDSxx	.79	.99	1.39	1.59	1.99	2.25
RIBBON HEADER	IDMxx	---	5.50	6.25	7.00	7.50	8.50
RIBBON EDGE CARD	IDExx	1.75	2.25	2.65	2.75	3.80	3.95

FOR ORDERING INSTRUCTIONS SEE D-SUBMINIATURE ABOVE

IDS34

IDE50

SWITCHES

SPDT	MINI-TOGGLE ON-ON	1.25
DPDT	MINI-TOGGLE ON-ON	1.50
DPDT	MINI-TOGGLE ON-OFF-ON	1.75
SPST	MINI-PUSHBUTTON N.O.	.39
SPST	MINI-PUSHBUTTON N.C.	.39
SPST	TOGGLE ON-OFF	.49
BCD OUTPUT	10 POSITION 6 PIN DIP	1.95

DIP SWITCHES

4 POSITION	.85	7 POSITION	.95
5 POSITION	.90	8 POSITION	.95
6 POSITION	.90	10 POSITION	1.29

HARD TO FIND "SNAPABLE" HEADERS

CAN BE SNAPPED APART TO MAKE ANY SIZE HEADER, ALL WITH .1" CENTERS

1x40	STRAIGHT LEAD	.99
1x40	RIGHT ANGLE	1.49
2x40	STRAIGHT LEAD	2.49
2x40	RIGHT ANGLE	2.99

SHORTING BLOCKS

GOLD CONTACTS SPACED AT .1" CENTERS

5/$1.00

Dear Mr. Rose:

I feel compelled to commend you and your people for the pleasant, polite, willingness to help and professional attitude you have displayed. In these times it is indeed refreshing to deal with a company whose staff consists of people of this caliber. My friends and associates will most certainly be doing business with you again.

Sincerely, Nicholas Chabra

RIBBON CABLE

CONTACTS	SINGLE COLOR 1'	SINGLE COLOR 10'	COLOR CODED 1'	COLOR CODED 10'
10	.18	1.60	.30	2.75
16	.28	2.50	.48	4.40
20	.36	3.20	.60	5.50
25	.45	4.00	.75	6.85
26	.46	4.10	.78	7.15
34	.61	5.40	1.07	9.35
40	.72	6.40	1.20	11.00
50	.89	7.50	1.50	13.25

CALL FOR VOLUME QUOTES

20MB HARD DISK SYSTEM ONLY $389.95!

BARGAIN HUNTERS CORNER

RGB MONITOR

HIGH RESOLUTION AND LONG PERSISTANCE P39 PHOSPHORUS ARE IDEAL FOR NO FLICKER CAD/CAM USE. IBM PC COMPATIBLE CABLE INCLUDED.

★ 14 INCH SCREEN ★ 16 TRUE COLORS
★ 25 MHz BANDWIDTH ★ FINE .31mm DOT PITCH
★ RESOLUTION GREATER THAN 640 x 262

$249

SPECIAL ENDS 11/30/86

PAGE WIRE WRAP WIRE

PRECUT ASSORTMENT
IN ASSORTED COLORS $27.50
100ea: 5.5", 6.0", 6.5", 7.0"
250ea: 2.5", 4.5", 5.0"
500ea: 3.0", 3.5", 4.0"

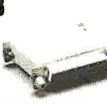
SPOOLS

100 feet	$4.30	250 feet	$7.25
500 feet	$13.25	1000 feet	$21.95

Please specify color: Blue, Black, Yellow or Red

EMI FILTER $4.95

* MANUFACTURED BY CORCOM
* LOW COST
* FITS LC-HP BELOW
* 6 AMP 120/240 VOLT



6 FOOT LINE CORDS

LC-2	2 CONDUCTOR	.39
LC-3	3 CONDUCTOR	.99
LC-HP	3 CONDUCTOR W/STD FEMALE SOCKET	1.49

MUFFIN FANS

3.15" SQ.	ROTRON	14.95
3.63" SQ.	ETRI	14.95
3.18" SQ.	MASUSHITA	16.95

WIRE WRAP PROTOTYPE CARDS

FR-4 EPOXY GLASS LAMINATE
WITH GOLD-PLATED EDGE-CARD FINGERS



IBM-PR2

IBM

BOTH CARDS HAVE SILK SCREENED LEGENDS AND INCLUDES MOUNTING BRACKET

IBM-PR1	WITH +5V AND GROUND PLANE	$27.95
IBM-PR2	AS ABOVE WITH DECODING LAYOUT	$29.95

S-100

P100-1	BARE - NO FOIL PADS	$15.15
P100-2	HORIZONTAL BUS	$21.80
P100-3	VERTICAL BUS	$21.80
P100-4	SINGLE FOIL PADS PER HOLE	$22.75

APPLE

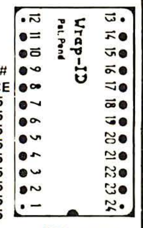
P500-1	BARE - NO FOIL PADS	$15.15
P500-3	HORIZONTAL BUS	$22.75
P500-4	SINGLE FOIL PADS PER HOLE	$21.80
7060-45	FOR APPLE IIe AUX SLOT	$30.00

SOCKET-WRAP I.D.™

* SLIPS OVER WIRE WRAP PINS
* IDENTIFIES PIN NUMBERS ON WRAP SIDE OF BOARD
* CAN WRITE ON PLASTIC; SUCH AS IC #

PINS	PART#	PCK. OF	PRICE
8	IDWRAP 08	10	1.95
14	IDWRAP 14	10	1.95
16	IDWRAP 16	10	1.95
18	IDWRAP 18	5	1.95
20	IDWRAP 20	5	1.95
22	IDWRAP 22	5	1.95
24	IDWRAP 24	5	1.95
28	IDWRAP 28	5	1.95
40	IDWRAP 40	5	1.95

PLEASE ORDER BY NUMBER OF PACKAGES (PCK. OF)



ID WRAP 24

FRAME STYLE TRANSFORMERS

12.6V AC CT	2 AMP	5.95
12.6V AC CT	4 AMP	7.95
12.6V AC CT	8 AMP	10.95
25.2V AC CT	2 AMP	7.95

25 PIN D-SUB GENDER CHANGERS $7.95

SWITCHING POWER SUPPLIES

PS-IBM $69.95

* FOR IBM PC-XT COMPATIBLE
* 135 WATTS
* +5V @ 15A, +12V @ 4.2A -5V @ .5A, -12V @ .5A
* ONE YEAR WARRANTY



PS-IBM

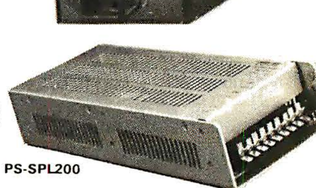
PS-IBM-150 $79.95

* FOR IBM PC-XT COMPATIBLE
* 150 WATTS
* +12V @ 5.2A, +5V @ 16A -12V @ .5A, -5V @ .5A
* ONE YEAR WARRANTY

PS-130

PS-130 $99.95

* 130 WATTS
* SWITCH ON REAR
* FOR USE IN OTHER IBM TYPE MACHINES
* 90 DAYWARRANTY



PS-A

PS-A $49.95

* USE TO POWER APPLE TYPE SYSTEMS, 79.5 WATTS
* +5V @ 7A, +12V @ 3A -5V @ .5A, -12V @ .5A
* APPLE POWER CONNECTOR

PS-SPL200 $49.95

* +5V @ 25A, +12V @ 3.5A -5V @ 1A, -12V @ 1A
* UL APPROVED
* ALUMINUM ENCLOSURE

PS-SPL200

CAPACITORS

TANTALUM

1.0µf	15V	.35	.47µf	35V	.45
6.8	15V	.70	1.0	35V	.45
10	15V	.80	2.2	35V	.65
22	15V	1.35	4.7	35V	.85
.22	35V	.40	10	35V	1.00

DISC

10pf	50V	.05	680	50V	.05
22	50V	.05	.001µf	50V	.05
27	50V	.05	.0022	50V	.05
33	50V	.05	.005	50V	.05
47	50V	.05	.01	50V	.07
68	50V	.05	.02	50V	.07
100	50V	.05	.05	50V	.07
220	50V	.05	.1	12V	.10
560	50V	.05	.1	50V	.12

MONOLITHIC

.01µf	50V	.14	.1µf	50V	.18
.047µf	50V	.15	.47µf	50V	.25

ELECTROLYTIC

RADIAL			AXIAL		
1µf	25V	.14	1µf	50V	.14
2.2	35V	.15	10	50V	.16
4.7	50V	.15	22	16V	.14
10	50V	.15	47	50V	.20
47	35V	.18	100	35V	.25
100	16V	.18	220	25V	.30
220	35V	.20	470	50V	.50
470	25V	.30	1000	16V	.60
2200	16V	.70	2200	16V	.70
4700	25V	1.45	4700	16V	1.25

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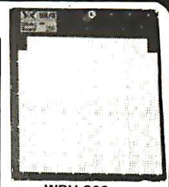
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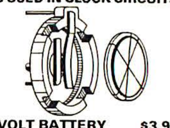
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WBU-D	.38 x 6.50"	1	100	---	---	---	2.95
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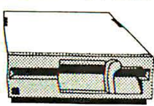
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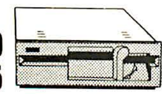
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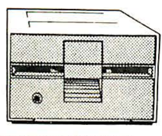
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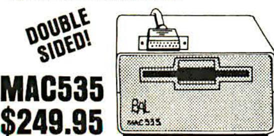


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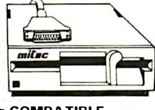


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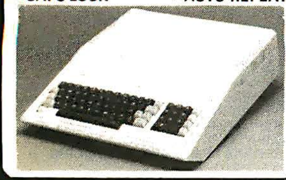
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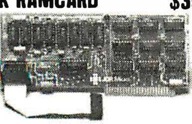
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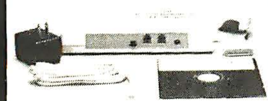
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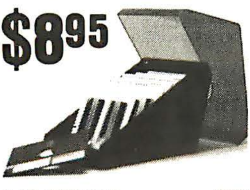
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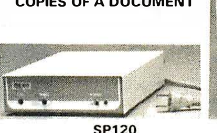
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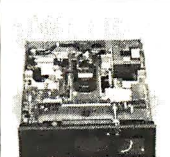
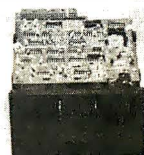
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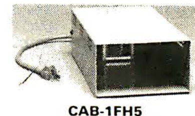
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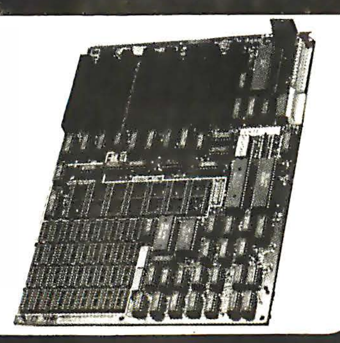
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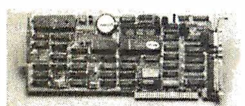
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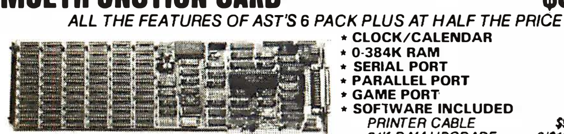


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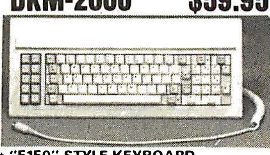
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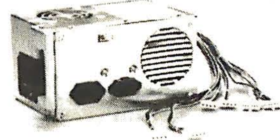
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BOMB *Results*

A DEFINITE WINNER

The winning article from the July issue was "The Definicon 68020 Coprocessor, Part 1: The Hardware and Operating System." Trevor Marshall, Christopher Jones, and Sigi Kluger will split the $100 prize. The second-place nonstaff-written article is "The Commodore 128 Personal Computer System" reviewed by William Wiese Jr. And winner of the $50 award for quality goes to the same three gentlemen listed above who coauthored "The Definicon 68020," making their total booty more easily divisible by three. Congratulations to all.

N·E·X·T M·O·N·T·H I·N B·Y·T·E

PRODUCT PREVIEW:
We anticipate that at least one newly announced product will receive its first public exposure in the November BYTE.

THEME:
Next month's theme, Representing Knowledge, includes articles about a Turbo Pascal program used to predict international events; a Pascal program for creating a knowledge base from a set of rules; Prolog as a tool for deductive reasoning; a way to use Prolog for resource management; and more.

HARDWARE REVIEWS:
You've heard the Mac Plus praised and blamed from a variety of sources; we'll tell you what it's really all about. On the other end of the spectrum, we'll present a look at the UNIX-based, multiuser Tandy 6000HD.

SOFTWARE REVIEWS:
Among the software reviews we have on hand and ready for publication are SPSS PC+; *FilePro 16*; and the much ballyhooed Aegis Animator for the Commodore Amiga.

CIRCUIT CELLAR:
Steve Ciarcia starts a three-part series on building a graphics board.

SPECIAL MC68000 SERIES:
68000 Memory Management Units

PLUS a programming insight or two; a programming project; and columns by Pournelle, Webster, Shapiro, Pountain, Kurosaka, and Raike; more from the Best of BIX; book reviews, What's New, Microbytes, and more.

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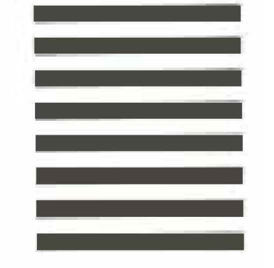
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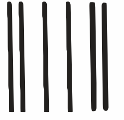
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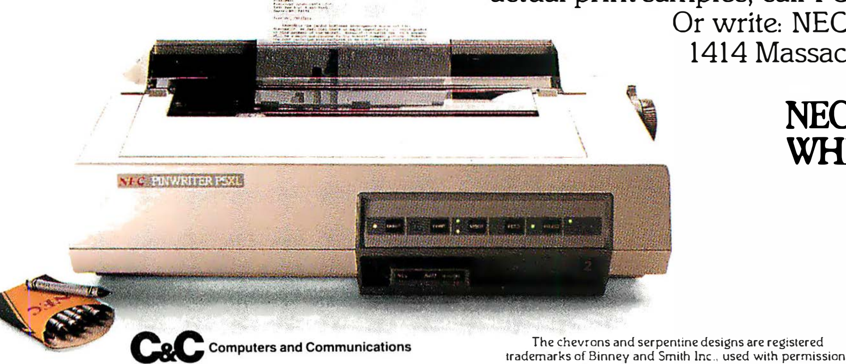
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